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HOUSE OF COMMONS SESSION 1998–99

SCIENCE AND TECHNOLOGY COMMITTEE

Third Report

SCIENTIFIC ADVISORY SYSTEM: MOBILE PHONES AND HEALTH

Volume II

Appendices to the Minutes of Evidence

Ordered by The House of Commons *to be printed*
2 September 1999
Pursuant to Standing Order No. 137

LONDON : THE STATIONERY OFFICE
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HOUSE OF COMMONS SESSION 1998–99

SCIENCE AND TECHNOLOGY COMMITTEE

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Third Report

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The Science and Technology Committee is appointed under Standing Order No. 152 to examine the expenditure, administration and policy of the Office of Science and Technology and associated public bodies.

The Committee consists of 11 Members. It has a quorum of three. Unless the House otherwise orders, all Members nominated to the Committee continue to be Members of it for the remainder of the Parliament.

The Committee has power:

(a) to send for persons, papers and records, to sit notwithstanding any adjournment of the House, to adjourn from place to place, and to report from time to time;

(b) to appoint specialist advisers either to supply information which is not readily available or to elucidate matters of complexity within the Committee's order of reference;

(c) to communicate to any other such committee and to the European Scrutiny Committee, to the Committee of Public Accounts, to the Deregulation Committee and to the Environmental Audit Committee its evidence and any other documents relating to matters of common interest; and

(d) to meet concurrently with any other such committee for the purposes of deliberating, taking evidence, or considering draft reports or with the European Scrutiny Committee or any sub-committee thereof for the purposes of deliberating or taking evidence.

The following were nominated Members of the Committee on 14 July 1997:

Mr David Atkinson
Mr Nigel Beard
Dr Michael Clark
Mrs Claire Curtis-Thomas
Dr Ian Gibson
Dr Lynne Jones
Mr Nigel Jones
Dr Ashok Kumar
Mrs Caroline Spelman
Dr Desmond Turner
Dr Alan W Williams

Dr Michael Clark was elected Chairman on 30 July 1997.

On 22 June 1998 Mrs Caroline Spelman was discharged from and Mrs Jacqui Lait added to the Committee.

On 30 November 1998 Mr David Atkinson was discharged from and Mr Ian Taylor added to the Committee.

On 5 July 1999 Mrs Jacqui Lait was discharged from and Mr Robert Jackson added to the Committee.

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1. Annex to Memorandum submitted by the National Radiological Protection Board
2. Annex to Memorandum submitted by the Department of Health
3. Appendices to Memorandum submitted by Northern Ireland Families Against Telecommunication Transmitter Siting
4. Appendices to Memorandum submitted by Orange Personal Communication Services Ltd
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7. Appendices to Memorandum submitted by Mr Stewart Anthony Fist
8. Annexes to Memorandum submitted by Carphone Warehouse
9. Appendices to Memorandum submitted by Mr Phil Willis MP
10. Appendices to Memorandum submitted by Joan Walley MP

APPENDICES TO THE MINUTES OF EVIDENCE

TAKEN BEFORE THE SCIENCE AND TECHNOLOGY COMMITTEE

APPENDIX 1

Memorandum submitted by Dr Alan W Preece, University of Bristol

1. I am a Reader in Medical Physics at the University of Bristol and Consultant Clinical Scientist at the United Bristol Health Care Trust. Since 1966 I have carried out clinical work and research into the interactions of humans and non-ionising radiation for the treatment and imaging of tumours and for physiological measurement in humans. I have a number of publications on both microwave interactions with human tissue and ELF dosimetry of humans, and have recently conducted direct studies of microwaves (mobile phone frequencies) on cognitive function and physiology.

1.1 My group are concerned with the following microwave studies:

(i) The Cell Phone Standardisation (CEPHOS) study in conjunction with the National Physical Laboratory and Bradford University Electrical Engineering Department, funded by the EU under Framework 4.

(ii) A risk perception study in persons living close to cell phone antennas, funded by the Department of Health.

(iii) A cognitive function study in human volunteers exposed to mobile phone use, also funded by the Department of Health.

2. The current levels of 10Wattskg^{-1} for head exposure advised by NRPB were originally set in 1988 in GS11 (incorporated in Documents of the NRPB Vol 4 No 5, 1993) at a time when mobile phone use was not foreseen. At that time I was a member of the *ad hoc* MRC Advisory Group advising the NRPB as a medical microwave specialist. The present situation of 11 million mobile phone users in the UK was not considered or envisaged.

2.1 It seems to me that with the length of exposure (30 minutes or more) by some individuals, the question of length of exposure may need to be considered as a factor in determining whether such exposure could be harmful.

2.2 This is particularly so, now that ICNIRP recommends limits of 2Watts kg^{-1} and the relevant USA limit is 1.6Watts kg^{-1}. Whether these more conservative limits are justified is unknown and although most modern handsets are below the lower limits, new technology with satellite telephones may alter this situation.

3. The mechanisms for revising the current UK intervention levels do not appear to me to serve the interests of the public.

3.1 Much of the information for revision is sifted by groups such as the CENELEC Committee that is chaired and populated with members with commercial interest or commercial connections. For this reason it is inevitably viewed with suspicion by the public at large, who demand that impartiality is crystal clear. Risk perception is coloured by the source of the information.

3.2 Where limits, or intervention levels, are to be advised by Committee, this Committee should include academics with bio-medical research experience who are free of industrial sponsorship.

3.3 Limits need to take account of the evidence from recent modelling and "in press" publications which have indicated that temperature rise in the brain will occur, even if this is small and possibly inconsequential.

4. Mobile phones have not been in use long enough, in sufficient numbers, for their implications for cancer to be obvious. Aetiology of cancer can be 20–30 years.

4.1 Epidemiological studies of association between phone use and tumours can only be in their infancy at this stage. However with so many users, if there is any risk at all this should be detectable in the right kind of study.

4.2 Prospective studies should be undertaken or set in place, if nothing else, to reassure the public that any risk, however small, is being considered.

4.3 Nothwithstanding the general scientific view (with which I concur) that even microwaves do not contain sufficient quantum energy to cause ionisation and thereby initiate cancer, it is essential that the reported DNA fragmentation effects (Lai & Singh) should be studied for possible replication or refutation with *all urgency*. The report of DNA fragmentation has been subject to peer review but is not supported by quantum theory, therefore a major doubt remains.

5. Aside from cancer, the other effects concern memory or other cognitive changes.

5.1 My own work shows that in the short-term there are no effects on memory, but this work gives no comment on long-term effects. However, a response by the brain has been demonstrated, which may simply be a mild physiological response to gentle warming. This work was published this year in the International Journal of Radiation Biology, in sufficient detail to be replicated.

5.2 A study of long-term effects must use data from mobile phone providers to obtain accurate information on phone use. Current activity by Motorola has made this research difficult, if not impossible. (See paragraph 7.2 and Annex).

5.3 There is an urgent need for what are called "provocation studies" on humans, ie a programme of cognitive and electrophysiological measurement during mobile phone use to exclude physiological effects or non-linear detection of mobile phone signals.

6. The engineering design of a handset can dramatically reduce head exposure.

6.1 There is a 10 to 20 fold difference between the different designs of hand-sets with respect to the power deposited in the brain of phone users. This study undertaken at the National Physical Laboratory using the CEPHOS realistic phantom head, showed very large differences between the different generic designs. Information on the emitted radiation level, or of tissue SAR, of each model should be made available to the consumer. This might relieve public anxiety about DECT phones.

7. Research opportunities in the UK, apart from those funded in the last round of calls by the Department of Health, seem to be few. The EMF Trust, the only source dedicated to electromagnetic field biological research, is primarily interested in power frequencies.

7.1 Several bodies have questioned me as to why the £100,000 of mobile phone research funded by the Department of Health should have been distributed as £3,400 to human memory research and £97,000 to the research in rat memory at DERA. Because of physical size reasons the rat brain may not be a good model of the human at mobile phone frequencies.

7.2 The recent initiative between the Mobile Manufacturers Forum (MMF) chaired by Motorola and WHO and CENELEC to direct applications to EU Framework 5 electromagnetic research funding has resulted in a strange imbalance in priorities for research, and excluded many laboratories from participation. (see Appendix[1]).

7.3 The effect is that providers and manufacturers have agreed only to collaborate with "approved laboratories". This list contains only two in the UK (one of these is NRPB), thus I am not satisfied that academic freedom and scientific support from many disciplines, including medical, can be ensured. A study involving "cognitive epidemiology" was aborted when no provider was free to collaborate with Swedish and UK laboratories. This is gross obstruction of research.

8. Summary

- The existing advice on exposure levels was not designed with mobile phones in view and may not be appropriate. There is much new evidence of temperature rise which makes the 10Watts per kg intervention level appear excessive.
- There is a great shortage, particularly in the UK, of funded work on mobile phone/human interaction, although there is plenty for engineering design and technology.
- There is urgent need to confirm or deny the work of microwave-induced DNA fragmentation, and a need to assess the possible relationship of tumour production and mobile phone use.
- There is a need to confirm or deny the existence of "non-thermal" microwave effects.
- Design of handsets has an enormous effect on human exposure. These figures should be in the public domain so that concerned individuals can make a choice.
- The interference by the Mobile Manufacturers Forum (MMF) in setting research priorities and selecting "competent" laboratories is not acceptable to an independent scientific community.

Annex

Report of the Research Planning Committee and following development of a Research proposal

Mays Swicord

MMF Research co-ordinator, Motorola Florida Research laboratories

INDUSTRY INITIATIVE IN DEVELOPING A CO-ORDINATED RESEARCH PROGRAMME

Assumptions:

- Studies of the highest quality which address the WHO agenda should be commissioned.
- Published studies which raise questions should be addressed.

Summer 1998 MMF took the initiative to establish a "Research Planning Committee" (RPC).

- Dr Alistair McKinlay—NRPB.
- Dr Bernard Veryet—Representing academic researchers.
- Jo Wiart—EBRC.
- Dr Mays Swicord.

Intent—to elaborate an industry proposal to address the WHO recommendations.

Input documents and background information.

- The McKinlay Report.
- WHO EMF Research agenda.
- Expert opinion sought through a series of workshops.

The MMF adopted RPC recommendations as a working programme in December of 1998.

This proposed agenda was presented to the WHO research co-ordination meeting in December 1998.

December 1998 MMF took the decision to commission WHO to hold a review panel to select suitable research laboratories.

PRIORITISED LIST OF STUDIES TO BE PROPOSED TO EU

Priority 1.

- Multi-country case control study co-ordinated by IARC.

Priority 2.

- Cancer related animal studies.
- GSM 1800 Bioassay:
  1. Mouse study.
  2. Rat study.
- GSM 900 Bioassay:
  1. Mouse study.
  2. Rat study.
- Replication studies
  1. PIM-1
  2. DMBA

Priority 3.
Provocation and Behaviour Studies

1. Human studies (double blind)
   - (a) Provocation Study on Sleep/EEG disturbances
   - (b) Provocation Study on Headaches (include blood pressure)
   - (c) Provocation Study on hearing
   - (d) Provocation Study on other concerns such as skin irritation
   - (e) Human study on working memory
2. Animal behavioural study to address Lai *et al.*

Priority 4.
In Vitro studies

1. ODC activity replication (Litovtz *et al*)
2. DNA aberrations

COMPARISON OF WHO AGENDA AND MMF PRIORITIES

WHO agenda item—two large-scale epidemiological studies—mobile telephone users—workers in industries with high RF exposures provided.

MMF Priority 1.

- Multi-country case control study co-ordinated by IARC

WHO agenda item

- Two more, large-scale standard 2-year animal bioassays using:
  normal animals
  animals initiated with chemical carcinogens or transgenic

MMF Priority 2—Cancer related animal studies

- GSM 1800 Bioassay:
  1. Mouse study
  2. Rat study
- GSM 900 Bioassay
  1. Mouse study
  2. Rat study
- Replication studies
  2. DMBA

WHO agenda item—two large studies, using designs similar to (1) above, to clarify the issues raised by PIM-1 study. (Second study in Australia)

MMF Priority 2—Cancer related animal studies

- Replication studies
  1. PIM-1.

WHO agenda item—Human studies to test people reporting specific symptoms such as

- headache
- sleep disorders
- auditory effects
- neurological effects (working memory and EEG)
- neuroendocrine effects
- immunological effects.

MMF Priority 3.
Provocation and Behaviour Studies

1. Human studies (double blind)
   - (a) Provocation Study on Sleep/EEG disturbances
   - (b) Provocation Study on Headaches (include blood pressure)
   - (c) Provocation Study on Hearing
   - (d) Provocation Study on other concerns such as skin irritation
   - (e) Human study on working memory

WHO agenda item—Additional studies performed on animals, but where possible, on human volunteers to test the reproducibility of reported changes

- effects on the eye
- inner ear (see vi, human studies)
- cochlea (see vi, human studies)
- memory loss
- neurodegenerative diseases
- neurophysiological effects

MMF Priority 3.

Provocation and Behaviour Studies

2. Animal behavioural study to address Lai *et al.*

WHO agenda item—*In vitro* studies have a lower priority . . . such studies can be of great assistance if they are directly relevant to possible *in vivo* effects, and address the issues of RF exposure thresholds and reproducibility for reported positive effects on cell cycle kinetics, proliferation, gene expression, signal transduction pathways and membrane changes. Theoretical modeling investigations can be useful if they support *in vivo* studies by proposing testable basic mechanisms of RF field exposure.

MMF Priority 4.

- *In vitro studies*
  1. ODC activity replication (Litovtz *et al*)
  2. DNA aberrations

IDENTIFICATION OF QUALIFIED LABORATORIES

Advertisement for qualified laboratories began in December 1998. Letters requesting expression of interest were sent to 25 laboratories and advertisements were placed in Archives of Toxicology, Lancet, Brain, and European Journal of Biochemistry, COST 244 and FGF newsletters.

Qualifying proposals were requested by Feb 26.

- 22 laboratories submitted 35 proposals for *in vitro* and *in vitro* studies.
- 18 laboratories submitted 34 proposals for human studies.

Review of proposals were conducted by independent expert panels administered by WHO

- March 8, 1999—*In vitro* and *in vivo* studies
- March 9, 1999—Human studies

IN VIVO AND IN VITRO PANEL

Dr Michael H Repacholi
- World Health Organization

Dr Christopher J Portier
- National Institute of Environmental Health Sciences, USA

Prof Victor J Feron
- TNO Nutrition and Food Research Institute, Toxicology Division, The Netherlands

Dr Robert Leboeuf
- Proctor and Gamble Eurocor, Belgium

Prof Manfred F Rajewsky
- Professor of Cell Biology (Cancer Research), Institute of Cell Biology, University of Essen Medical School, Germany

HUMAN STUDIES PANEL

Dr Michael H Repacholi and Dr Christopher J Portier

Prof Jim Horne
- Loughborough University, Department of Human Sciences, UK

Dr Conrad Hauser
- Allergy Unit, Division of Immunology and Allergy, University Hospital, Geneva, Switzerland

Prof Andrew Smith
- Dept Experimental Psychology, University of Bristol, UK

OBSERVERS

Mays Swicord—MMF Research Co-ordinator

Torsten Gailus—Deutsche Telecom

Gerd Friedrich—FGF

Guglielmo D'Inzeo-Elettra 2000

Panel Criteria for Ranking

1. Lab is clearly capable of conducting the research with, at most, only minor concerns.
2. Concern with some aspects of the abilities of the lab, but the lab is still capable of doing the research.
3. Substantial concerns about the lab that need to be addressed before being considered for the research.
4. Insufficient information provided to make an assessment.

QUALIFIED LABS SELECTED TO CONDUCT IN VIVO CANCER RELATED STUDIES

Study type	*Experiment*	*Laboratory*	*Country*
2 year Chronic Bioassays			
	RAT-1	RCC Switzerland	Switzerland
	Rat-2	RCC Switzerland	Switzerland
	Mouse-1	Frauenhofer Hanover	Germany
	Mouse-2	Frauenhofer Hanover	Germany
Pim 1 Transgenic Lymphoma Bioassay		BioScience Italy	Italy
DMBA Initiated Mammary Tumor Bioassay		ARCS Seibersdorf, Austria	Austria

Qualified Labs Selected to Conduct *in Vitro* Cancer Related Studies

Study	*Laboratory*	*Country*
ODC Enzyme Activity	PIOM Bordeaux	France
	DES-Kupio	Finland
Genetoxicity	ENEA Rome	Italy
	NRPB	England

QUALIFIED LABS SELECTED TO CONDUCT NON-CANCER STUDIES

Study	*Laboratory*	*Country*
Animal Behavioural Studies	ULP, France	France
Animal Behavioural Studies	NRPB + Bordeaux support	England &France
Skin Hypersensitivity	Karolinska Institute, Arnetz	Sweden
Headaches	Karolinska Institute, Arnetz	Sweden
Blood Pressure	Karolinska Institute, Arnetz	Sweden
Hearing	Karolinska Institute, Pyykko	Sweden
Day Exposure/Sleep	Karolinska Institute, Akerstedt	Sweden
Working Memory	Cambridge MRC Cognition Brain Sciences—Adrian Owen	England

APPENDIX 2

Letter to the Committee Specialist from the Trades Union Congress

Thank you for your letter of 21 May asking the TUC to submit evidence for the above enquiry. I am afraid that the TUC has very little to contribute on the specific subject of mobile phones, although some of our unions representing staff who use them a considerable amount may well have something to contribute, such as the Communication Workers Union.

The TUC could provide general evidence on the advisory systems used to deal with workplace health and safety (principally the Health and Safety Commission) if that would be helpful, but, again, these bodies have done little with regard to mobile phones.

Perhaps our main concern would be to stress that the health effects of mobile phones are bound to be different to the health effects of mobile phone use, including stress, increased risk of accidents and so on; and that we would want any advisory system to consider those wider issues rather than concentrate solely on the health effects of the actual equipment. Bluntly, our perception is that mobile phone use is likely to have more of an effect on road traffic accidents than on, for example, brain tumours.

7 June 1999

APPENDIX 3

Memorandum submitted by Northern Ireland Families Against Telecommunication Transmitter Siting (NIFATT)

1. INTRODUCTION

NIFATT is a cross-community organisation which represents over 70 community groups throughout Northern Ireland. Approximately 65 similar groups from the South of Ireland are affiliated to NIFATT, and the organisation also has strong links with groups from England and Wales.

NIFATT was created in 1997—in response to the seemingly uncontrolled proliferation of mobile telecommunications masts throughout the province. In the intervening two years it has established contact with similar organisations, scientists and politicians throughout Europe, the USA, Australia and New Zealand.

2. QUALITY AND OBJECTIVITY OF ADVICE PROVIDED AT THE PRESENT

2a *Advice provided by Government Departments*

NIFATT recently provided support for the residents of Ballymacashen in County Down as they took a case to Belfast High Court for judicial review. Legal proceedings began in September 1998 and judgement was delivered, in their favour, on 23 April 1999. To date, this has been the first successful judicial review in the UK. As part of the judicial review the court admitted an affidavit specifically on the health issues (Annex 1). Insofar as we can ascertain, this is the first time that any court in the world has admitted such evidence for examination. Professor Henry Lai and Dr Gerald Hyland provided expert evidence for inclusion in this affidavit. (Their findings will be submitted individually to the Committee, and are therefore not included in this submission).

In November 1997, a statement on the health risk of exposure to microwave frequency radiation was sent from the Chief Environmental Health Officer for NI to all Borough Councils in NI. To date, an identical statement has been provided by DoE Planning Service to any member of the public enquiring as to possible health effects. The statement reads as follows: "there is no firm evidence for the existence of a carcinogenic hazard from exposure to electromagnetic fields in the electrical, electronic or telecommunications industries". The original source of these words has been traced to a 1992 NRPB Report of the AGNIR (Appendix 2)[1] "*Electromagnetic Fields and the Risk of Cancer*". The subject of this report—far from being the high frequency radiation emitted by mobile phones and base stations (900–1800 MHz)—is actually extremely low frequency power radiation (50–60 Hz). Confirmation of this fact was provided by Dr John Stather, Deputy Director of the NRPB (Radiological Protection Bulletin No 183, November 1996, pp38-41).

Thus, the words contained within the statement "there is no firm hazard. . ." have been selectively excised from a much longer paragraph—with the result that all reference to extremely low (power) frequency radiation has been effectively removed.

The Chief Environmental Health Officer for NI (Mr Morris McCallister) and the Minister (Mr John McFall) have been asked by NIFATT to provide a satisfactory explanation for the misleading advice on health which has been disseminated to the public of NI. Towards the end of May 1999, both Mr McCallister and Mr McFall provided written confirmation that the 1992 NRPB report, from which the statement on health had been excised, did not address mobile telephone frequencies. However, despite this admission, there has been no indication whatsoever that a new statement on health has been prepared.

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[1] Not printed.

2b *Advice provided by the Industry*

As recently as summer 1998, whilst searching for suitable mast sites in NI, Orange PCS distributed a document entitled *"Radio Safety Information"* to landowners (Annex 2). It must be borne in mind that, prior to signing a contractual agreement with Orange PCS, this is generally the only safety information that a landowner reads. This report contains statements that are quite clearly incorrect:

Page 1. Guideline distances for non-hazardous RF exposure. All of the distances quoted for base station antennas are clearly at odds with the NRPB information sheet on mobile phone base stations (Appendix 4)[2] which states "Experience with typical installations has shown that there may be regions within a few metres, directly in front of the antennas, where radio waves can exceed the NRPB guidelines".

Page 2. Exposures limits: "completed intensive research failing *(sic)* to establish a hazard"

Cellnet have recently produced an Environmental Policy Statement. This publication is available only on the Intranet and, therefore, not intended for public consumption (Appendix 5)[3] . Point number four is as follows: "Cellnet in particular will: Reduce the level of harmful emissions, which may be produced by our operations".

2c *Conclusions*

The issues over health remain largely unresolved. The NRPB continues to adhere to thermal exposure limits set down at the end of the 2nd World War—and appears unwilling to accept even the concept of non-thermal effects. However, a personal communication dated September 1998 from Dr John Stather to the Secretary of NIFATT (Appendix 6)[2] states the following "I cannot, however, give you an absolute categorical statement that non-thermal effects pose absolutely no health risks to nearby residents". The Planning Authorities throughout the UK continue to look to the NRPB for advice on health. This advice is, quite clearly, outdated and inaccurate. Despite the continuing EU and WHO research programs, the populations who live and work near these masts continue to be exposed day after day—their basic human rights have been sacrificed in the pursuit of profit.

Independent scientists working in this area of research are beginning to provide evidence that these non-thermal effects do exist (Appendix 7)[4] and that the long-term health of many UK citizens may well suffer as a result of chronic exposure to low levels of microwave frequency radiation.

3. THE FUTURE

There is clearly a need for much more Government-funded independent research. Such research will take a number of years to complete, and a further period of time will elapse before results are analysed fully.

Until then, the precautionary approach should be adopted. Even in the short term, various steps could be taken in order to provide some measure of protection to the public including:

(1) Removal of Prior Approvals Procedure from the planning process and replacement with a requirement for full planning permission. This should apply to all new masts, and alterations to all existing masts. This would also have the effect of doubling the planning notice period from four to eight weeks.

(2) Requirement for central Government to implement buffer zones between homes, schools and hospitals and masts. In rural areas this is not a logistical problem for any of the Telecommunications operators—merely a financial one.

(3) Rationalise and relocate all existing masts to enable site sharing away from the public.

(4) Independent, unannounced monitoring of all sites—costs to be met by Industry.

(5) Immediate retrospective investigation into frequency of ill health and causes of death amongst telecommunications industry workers. Health-monitoring of current employees.

(6) Public declaration of interests of "independent" advisors to Public, Government and NRPB.

9 June 1999

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[2] Not printed.

[3] Not printed.

[4] Not printed.

Annex 1

IN THE HIGH COURT OF JUSTICE IN NORTHERN IRELAND
QUEEN'S BENCH DIVISION

In the Matter of an Application by James Nicholson and Ruby Hooks for Judicial Review and in the Matter of a decision of the Department of the Environment on or about 17 August 1998 not requiring Orange PCS Limited to apply for planning permission in respect of a site at Ballymacashen Road, Killinchy, and in the Matter of a decision of Orange PCS Limited in respect of the erection of a telecommunication mast at Ballymacashen Road, Killinchy.

I, Hilary Kennedy of 16 Ballymacashen Road, Killinchy, County Down, Biochemist, being aged 18 years and upwards make Oath and say as follows:

(1) I am a Biochemist, having been a Research Fellow for some 11 years and have a number of peer reviewed publications in prestigious scientific journals.

(2) I live at 16 Ballymacashen Road, Killinchy, County Down.

(3) I depose to the following from facts within my own knowledge, save where otherwise appearing.

(4) I have become increasingly concerned with the health issues arising from the installation of telecommunication masts and the manner in which these issues are being dealt with by the telecommunications industry, the Chief Environmental Health Officer and the Planning Department.

(5) I was consulted by Mr and Mrs James Nicholson with regard to correspondence received by them from Mr Eric Carson, General Manager for Orange N.I., dated 14 and 18 September 1998, copies of which are exhibited hereto marked "HK1". At paragraph 5 of the letter dated 18 September Mr Carson states " . . . I would urge you to examine the facts regarding radio safety and to consult independent fully qualified experts, either at Queens University or University of Ulster who can offer an objective and informed view on radio safety and have been requested by Councils throughout Northern Ireland to give their expert opinion on the subject". Mr Carson continues at paragraph 6 of the same letter to say " . . . we have learned that the World Health Organisation recently dropped the study of radio masts (and populations which live near them) off its research agenda on the basis that radio field levels around base stations are not considered to be a health risk.

(6) I immediately wrote to the Director of Environmental Health at Ards Borough Council requesting information and I received his response dated 29 September 1998, enclosing a letter from the DHSS, which letter has previously been exhibited to the Affidavit of James Thompson filed on 7 October 1998 at exhibit "JY9". This letter refers to the Advisory Group on Non-ionising Radiation (AGNIR) chaired by Sir Richard Doll and quoted from their findings in 1992 as follows: "the group concluded that there was no firm evidence for the existence of a carcinogenic hazard from exposure to electromagnetic fields in the electrical, electronic or telecommunications industry. A review of current research is presently being undertaken by AGNIR". I obtained a copy of this report which has been previously exhibited to the Affidavit of Ann Elizabeth Ervine filed on 15 December 1998 as exhibit "AEE1". I was deeply disturbed that this report was quoted as this was a report primarily concerned with the effects of exposure to power frequency EMFs (50Hz) generated by mains electricity supply and by the use of electrical equipment—not telecommunications base stations. (900–1800 MHz). Confirmation of this is found in a report by John Stather of the NRPB, published in November 1996, the relevant extract from which is exhibited hereto as "HK3".

(7) Equally the conclusions quoted in the letter of the Chief Environmental Health Officer were very selectively quoted and I felt, quite misleading. The full quotation reads " . . . . no firm evidence of the existence of a carcinogenic hazard from exposure of paternal gonads, the foetus, children or adults to the extremely low frequency electro magnetic fields that might be associated with residence near major sources of electricity supply, the use of electrical appliances or work in the electrical, electronic, and telecommunications industry". My concerns were such that I, with three others attended a meeting with Ards Borough Council on 19 October 1998 at which we asked Mr Rea, Director of Environmental Health at Ards Borough Council to write to the Chief Environmental Health Officer for clarification on the Department's comments contained in his letter of 19 November 1997. A copy of Mr Rea's letter, without enclosures, was sent to me and is exhibited hereto as "HK4". To the best of my knowledge and belief Mr Rea has not yet received any response to that letter.

(8) I became aware through the media that Orange PCS Limited, in line with their letters of 14 and 18 September 1998 to Mr & Mrs Nicholson were putting forward as independent and fully qualified experts, Dr William Scanlon of the University of Ulster and Mr Alan Edgar of Queens University, Belfast. I carried out a database search of peer reviewed scientific publications to ascertain on what basis these gentlemen could be referred to as "fully qualified experts". With regard to Dr Scanlon I discovered that from 1981 to 1998 he has published two papers relating to the measuring of human vaginal temperature whilst a search against Mr Edgar revealed that from 1981 to 1998 he appears to have had no publications of any sort. Copies of my database searches are exhibited hereto as "HK5". With regard to their independence I understand that Dr Scanlon is on public record at a

meeting of Newry & Mourne District Council on or around 10 December 1998 as admitting that he has had connections with and worked for telecommunications companies and was not truly independent.

(9) At the same time I had sought verification of Mr Carson's assertion in his letters of 14 and 18 September 1998 to Mr & Mrs Nicholson that the World Health Organisation had dropped the study of radio masts. I communicated with a Mrs Margaret Dean whom I know to be in contact with Dr Mike Repacholi, Head of EMF Studies at the World Health Organisation. She received a response by E Mail from Mike Repacholi on 21 September 1998 indicating that the World Health Organisation had not removed mobile telephone base stations from their research agenda to investigate health risks. A copy of Mrs Dean's enquiry and Dr Repacholi's response are exhibited hereto and marked "HK6".

(10) Accordingly on 17 December 1998 I wrote directly to Mr Eric Carson at Orange Telecommunications setting out my concerns with regard to Dr Scanlon and Mr Edgar. Mr Carson's response to this letter was dated 23 December 1998 and prompted a response from myself to him dated 29 December 1998. All of these letters are exhibited hereto and marked "HK7". I can confirm that I have not had any response to date to my letter of 29 December 1998.

(11) I have spoken to Dr Gerard Hyland of University of Warwick, whom I am satisfied has appropriate qualifications and expertise in the particular field of microwave radiation on humans. I requested Dr Hyland to let me have his professional opinion which I received in a faxed letter dated 12 January 1999, which letter is exhibited hereto marked "HK8". Dr Hyland's qualifications are clearly set out on the front of this letter and a list of his publications contained at the end.

(12) I have also obtained from Dr Henry Lai of Department of Bioengineering, University of Washington, a copy of his recent paper on the Neurological Effects of Radiofrequency Electromagnetic Radiation. Extracts relevant to telecommunications cell masts are exhibited hereto marked "HK9".

SWORN at Chichester Street, Belfast this 15 January 1999 before me a solicitor empowered to administer Oaths.

This Affidavit is filed on behalf of the applicant by McMillan & Ervine, of 31 Main Street, Saintfield, solicitors for the Plaintiffs.

Annex 2

RADIO SAFETY FOR ORANGE RADIO SITE

GUIDELINE DISTANCES (METRES) FOR NON-HAZARDOUS RF EXPOSURE IN THE PROXIMITY DIFFERENT ORANGE PCS ANTENNAS

(A) BASE STATION ANTENNAS

120 Sector Antenna

Front (150° around boresight)	0.98m
Rear (210° around rear)	0.07m
Above and Below	0.07m

OMNI Directional Antenna

360° around the Antenna	0.25m
Above and Below the Antenna	0.03m

Microwave Dish Antennas

There is no risk around these Antennas

(B) ENHANCER SYSTEM ANTENNAS

Antenna	*Gridpak Dish*	*Yagi*	*120° Sector*	*65° Sector*	*Panel*	*Ceiling Mount*
Front	0.21	0.46	0	0	0.13	0.07
Back	0.02	0.15	0	0	0	0
Below	0.02	0.15	0	0	0	0

(C) Paging Antennas

OMNI Directional Antenna

360° Level with the Antenna	3.75m
Above and Below the Antenna	0.35m

The use of the radio spectrum has developed considerably over the last 70 years and is being extensively used in a wide range of business, public sector service, scientific and social applications.

Today's radio services are of considerable relevance to the economy allowing radio technology to be an important and crucial element of a society's information and entertainment needs.

Nowhere has this been seen more clearly than in the popularity of mobile communications which allows people to keep in touch whilst on the move.

Orange is aware of its responsibility to the public and the employees and constantly reviews the recommendations used within the UK and Europe in respect of the effect of radio emissions on radio sites operated by Orange PCS.

Why Radio Transmissions?

The use of radio transmissions has increased over the years as equipment has become smaller and more readily available to the general public. In the last few years, greater use of cellular paging and other radio based systems have been used to supply information to people on the move.

Radio transmission sites are operated throughout the UK by various organisations who operate public and private communication networks and radio services. All these systems have been licensed under Government Regulations and are required to meet the Department of Trade and Industry Regulations on their use. The power transmitted by the cellular and paging systems is generally very small compared to broadcast radio systems.

In April 1994, Orange PCS launched a national, digital network, operating at a higher frequency of 1,800 MHz, using a technology called DCS 1,800. This is commonly known as a Personal Communications Network (PCN).

Under the terms of its Licence, issued by the DTI in July 1991, Orange is required to provide Mobile Communications services to meet all reasonable demands for the provision of its service.

In granting new PCN licences, the Government continues to introduce increased competition onto the telecommunication market, resulting in more choice for the customer, improved service and lower costs.

PCN is a mass market, consumer telecommunications service providing value for money, which in turn requires a corresponding level of high quality, national coverage.

Exposure Limits

As the demands for radio service increases and its importance has grown, the possible concerns of radio waves to health is causing confusion and concern, with the completed intensive research falling to establish a hazard.

Safety is key for everyone who works with radio and precautionary standards are endorsed by leading international health organisations.

Orange is clearly aware of its responsibility to the public and employees in the operation of a safe network and works within the recommendations used in the UK and Europe.

The most significant parameter concerning Health and Safety aspects of radio frequency transmissions is the power absorption rate which is expressed in watts per 1 kg. In Europe, the current reference level of exposure by the general public to radio signals that Orange operate is a power density of $9Wm^{-2}$. These recommendations have been used by the National Radiological Protection Board (NRPB) who are an independent UK agency and CENELEC, the European Committee for Electrotechnical Standards.

Orange calculates worst case guideline safety distance at which the reference levels given by CENELEC are reached. Even at these distances it is unlikely that any risk is present. The recommendations produced by the NRPB on safety levels were prepared in 1988 and revised and re-issued in 1993 and those set by CENELEC in 1995. The CENELEC standards have been used to set the guideline safety distances used for Orange installations. These are shown in Table 1.

The power transmitted by the cellular and paging systems is very small (similar to that used by a Taxi radio) compared to broadcast TV, radio and radar systems. Radio transmitter signals decrease rapidly over distance.

RADIO SITE INSTALLATIONS

Orange will carry out measurements on actual sites to ensure standards are met and can demonstrate compliance, if concerns are expressed.

Orange is meeting its licence obligations to the DTI, and the use of radio equipment which must comply to the current specifications. These requirements and the meeting of the NRPB UK and the tighter CENELEC guidelines on RF emission, mean that requirements for safe radio transmissions from Orange sites are met. Orange site installations will have no effects on the general public in the surrounding area.

Reference Documents

National Radiological Protection Board (NRPB) document NRPB-GS11-1993

HMSO, £10.00, ISBN 0 85951 3661

CENELEC Document ENU 50166-2 January 1995

American National Standards Institute (ANSI) document ANSI C95.1, 1990

Issued by

S C Collins, Head of Central Operations, Orange PCS Limited, Great Park Road, Almondsbury, Bristol BS12 4QJ

APPENDIX 4

Memorandum submitted by Orange Personal Communications Services Ltd

Letter to the Clerk of the Committee from Mr Paul Franklin, Group Director of Carrier Services & Regulatory Affairs, Orange Personal Communication Services Ltd

I am pleased to enclose Orange's Memorandum relating to the Science and Technology Committee's inquiry into the Scientific Advisory System: Mobile Phones and Health examining the processes and structures the Government uses to obtain and consider scientific advice on this matter.

Orange has contributed to and fully supports the Memorandum submitted by the Federation of the Electronics Industry. Our submission therefore does not repeat the information provided in that submission but adds specific information on how Orange implements the Government and advisory body regulations and guidance and how Orange ensures that it is fully compliant with these requirements.

11 June 1999

Memorandum by Orange Personal Communication Services Ltd

1. INTRODUCTION—BACKGROUND ON ORANGE

1.1 Orange Personal Communication Services Ltd ("Orange") is licensed under the Telecommunications Act 1984 and the Wireless Telegraphy Act 1949 to provide mobile radio telecommunications services in the UK. The principal business of Orange is the operation of the Orange digital GSM 1800 telecommunications network in the UK and the sale and marketing of Orange services.

1.2 Orange has rapidly established itself as a high quality digital mobile telecommunications provider in the UK. Orange network service covers over 98 per cent of the UK population and Orange now has more than over 2.8 million customers.

1.3 Orange makes a significant contribution to the UK economy. It employs nearly 6,000 people in the UK, mainly in the company's principal locations in Bristol, Hertford, Darlington, Peterlee, Banbury and London. Orange is the largest private sector employer in the Darlington area. Orange has to date invested over £1,400 million in the Orange network in order to deliver Orange's vision of a wirefree future, where people will communicate wherever and whenever they want.

1.4 Orange aims to meet the current and future demands of consumers and business customers and to become a part of their everyday lives. Mobile communications is a vital business tool and encourages increased productivity. By helping UK industry to become more efficient, mobile communications has become an essential factor of the UK's increasing world-wide competitiveness.

1.5 The mobile market in the UK is one of the most advanced in the world in terms of competition, quality, choice and value for money. With increased consumer interest in mobile telephony, demands for services are increasing and customers' requirements are also becoming more sophisticated. The UK mobile industry is developing more advanced, high speed, high quality interactive services to meet customers' demands to be able to access voice and data services on the move wherever they are.

1.6 The Government is currently preparing to auction additional spectrum to provide for the 3rd generation of mobile communications. The UK will be amongst the first countries in the world to award such licences, maintaining the UK mobile industry's leading global role in developing the future of mobile telephony technology, standards and services. Consumers in the UK will benefit from new innovative and exciting multimedia services delivered across mobile systems and providing new opportunities for economic, social and public policy benefits for the UK.

1.7 Orange is committed to continue:

- expanding and improving its digital network in the UK;
- providing innovative, value for money services as expected and demanded by customers;
- providing high quality customer care; and
- ensuring full compliance with all national and international regulations and guidelines to deliver safe and efficient mobile communications.

2. Compliance and Communication

2.1 Orange welcomes the inquiry into the Scientific Advisory System. Orange cares about the welfare of its customers and is responsive to any public concern about alleged adverse health effects from mobile phone use and the operation of mobile networks. Together with the UK and international mobile telecommunications industry, Orange is committed to addressing these concerns and acting responsibly by providing clear and robust information to its customers, the Government and other concerned stakeholders and reacting to new recommendations, where appropriate.

2.2 Through its membership of the Federation of the Electronics Industry (FEI), Orange has been involved in the preparation and submission of the FEI's Memorandum to the Scientific Advisory System Inquiry: Mobile Phones and Health. Orange supports and endorses the position outlined in the FEI's Memorandum.

2.3 Orange is committed to supporting the work of the FEI and related international industry trade associations in reassuring its customers, employees, the general public and other stakeholders with respect to any alleged health effects related to the use of mobile phones. Orange will continue to examine all available scientific evidence relating to the safety of mobile handsets and mobile network base stations.

2.4 Orange constantly reviews the recommendations and guidance issued within the UK and Europe through a management process that ensures that handsets used on the Orange network and the operation of the Orange network itself remain fully compliant with the relevant guidelines.

2.5 With regard to the operation of the Orange network, independent measures in the vicinity of Orange base station sites indicate that all areas accessible to the public and staff operate significantly within the recommended safety reference levels. Procedures are in place to assure the safety of staff who need access to base stations for maintenance needs.

2.6 Mobile phones operating on the Orange network are designed, manufactured and operate well within NRPB and European safety guidelines. Orange works closely with handset manufacturers to ensure compliance with all relevant standards.

2.7 Orange produces a number of documents (available both in written and electronic form) which provide objective and factual answers to frequently asked questions from employees, customers and other audiences on mobile phone health issues and base station siting issues.

2.8 These documents support a programme of liaison meetings held by Orange with different audiences to achieve a better understanding of radiowave issues and to address consumer perceptions over suggested health concerns.

2.9 Orange takes its responsibility in this area very seriously. Orange is an active member of the FEI's Public Radio Telecommunications Committee and, internationally, the GSM Association (the group representing all mobile telecommunication networks world-wide that use GSM technology). As an example of the level of commitment within the industry, the GSM Association has agreed in principle to fund 25 per cent of the European Union's Fifth Framework program to address possible health effects related to the use of radio telephones.

2.10 Through such industry activity, Orange will continue to support and participate actively in work and research to clarify the existence, if any, and extent of any health concerns arising from the use of mobile phones.

2.11 Please find attached the following documents as appendices[5]:

Document 1 "Radio Emissions": a current document taken from the Orange Intranet which gives an objective and factual position to employees on mobile phone health and base station siting issues.

Document 2 "Healthwatch": an article taken from "O" Magazine (April 1999), a quarterly magazine sent to Orange customers, which gives an independent position on mobile phone health and base station siting issues.

11 June 1999

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[5] Not printed.

APPENDIX 5

Memorandum submitted by the British Medical Association

The British Medical Association is a professional organisation representing all doctors in the UK. It was established in 1832 to promote the medical and allied sciences, and to maintain the honour and interests of the medical profession.

I am pleased to provide responses to the headings provided.

The quality and objectivity of the advice provided at present

Mobile phone companies should provide more information to the consumer about the emission of non-ionising radiation from their phones, and reassurance about the degree of hazards and risks to users. Consumers should be provided with information on hands-free systems and radiation shields when purchasing mobile phones

The suitability of current procedures and structures for obtaining good quality scientific advice

New research into the potential biological hazards from mobile phones is needed and the current structures of disease surveillance in the UK need to be strengthened in order to detect any unusual increase in illnesses associated with mobile phone use.

The processes for assessing scientific advice in policy making and regulation

Currently all internationally recommended limits for mobile emissions are set on the assumption that the only damage that could be caused is from the well known heating effects of microwaves. We need to consider effects below the thermal threshold levels, particularly the possibility that they can promote the development of cancer caused by other agents.

The extent to which there are grounds for health concerns.

See under "the need for further research".

The opportunities for new technologies to reduce health risks.

Research is needed to establish the degree of protection afforded to the consumer by using safer accessories to mobile phones, such as hands free kits. For example, there has been concern that they may intensify radiation exposure to the ear canal, or that they may redirect exposure to another part of the body—eg many are carried at the waist.

The need for further research.

There is a clear need for further long-term research into the health effects of mobile phones, and both the thermal and non-thermal biological effects of high-frequency radiation. Particular attention should be paid to effects on children, from both transmitter base station and hand held telephones. The New Zealand Ministry for Education, for example, has issued a policy statement preventing cellular phone antennas from being sited at state schools in the future.

There have been a few studies indicating adverse effects from mobile phones, however these studies at present are based on too few examples to draw valid conclusions. There is a need for large-scale epidemiological studies to determine their safety, which should be coordinated by a major body such as the MRC.

While scientific evidence remains inconclusive we should take precautionary measures to minimise exposure, and encourage further research.

11 June 1999

APPENDIX 6

Memorandum submitted by Alasdair MacLean Philips, Director, Powerwatch

1. INTRODUCTION

1.1 I am Director of Powerwatch, an "independent" consumer information service founded 10 years ago which gives information regarding the possible adverse health effects of non-ionising radiation. We collect and evaluate world scientific literature in the field of bio-electromagnetics and attempt to supply the enquiring public with unbiased information about the possible hazards (and advantages) that have been associated with our use of electricity, radio and microwaves. We also hire out meters for measuring fields. We do not sell any so called "protection devices or gadgets".

We contribute to the "Electromagnetic Hazard & Therapy" quarterly newsletter and we are currently web-site linked next to the NRPB on the BBC Internet news pages.

1.2 I am recognised as an "independent" UK voice on the possible adverse health effects of non-ionising radiation and I have given Expert Evidence on Electric and Magnetic Fields (EMF) bioeffects in Judicial Reviews, Public Inquiries, Wayleave and Lands Tribunal Hearings and at the 1998 Coghill "Mobile Phone Warning Labels" case. I have been involved with technical aspects of mobile communications for over 30 years and have also worked in agricultural science research.

I am a Consultant in the areas of Electromagnetic Compatibility (EMC), advising on design of equipment to pass the European and UK EMC Regulations. I am a member of the OFFER Eastern Electricity Consumers' Committee. I have written and published extensively on EMF and health issues. In 1996 I was Team Leader for a Survey and Report on the possible health consequences of the Kuwait cellular telephone system which was commissioned for the Kuwait Government by the Kuwait Institute of Scientific Research. I am Chairing the first day of a two-day international conference on mobile phone safety to be held in Götenborg, Sweden, in December 1999.

2. SUMMARY

Powerwatch seems to be the only UK group that knowledgeably serves the interest of consumers. Due to the NRPB's denials that mobile phone use can cause adverse health problems, many mobile phone users who are experiencing problems are usually treated by their GP for a psychological problem and given tranquillisers or anti-depressants. In many cases telling them to reduce or stop their mobile phone use is all that is necessary. I believe, and attempt to show, that:

2.1 . . . the current advice on these matters provided by the UK National Radiological Protection Board (NRPB) is inadequate and flawed and does not incorporate the Precautionary Principle which both this and previous UK Governments have accepted should apply in matters of health and environment. [see Section 3]

2.2 . . . current procedures for obtaining good quality scientific advice are flawed. [Section 4]

2.3 . . . the current system of the NRPB providing "advice" to the DoH and the DETR includes seconding staff to the DoH to draft official guidance and has produced unhealthily close links with little independent "third party" input being possible. The UK lacks an open and objective forum for evaluation of both scientific and technical information and also for draft official public policy based on this evaluation. [see Section 5]

2.4 . . . there is enough good scientific evidence now available to require health warning labels to be affixed to all mobile phones. [see Section 6]

2.5 . . . there is clear need for further urgent research free from industry influences which seem to be present even where the WHO EMF project is concerned. [see Section 7]

Table 1

DIFFERENT STANDARDS FOR GENERAL PUBLIC EXPOSURE LEVELS

(900 and 1,800 MHz are the two main existing UK mobile phone bands)

General Public Reference Bodies	*Frequency MHz*	*E field V/m*	*Power W/m²*	*Power µW/cm²*
NRPB, 1993	900	112	33	3,300
(Current UK Investigation Levels)	1,800	194	100	10,000
ANSI, 1990 (USA)	900	47	6	600
IEEE C95.1–1992 (USA)	1,800	66	12	1,200
ICNIRP, 1998 (recognised by WHO)	900	41	4.5	450
CENELEC, 1995 (EU)	1,800	58	9	900
Two USA research bases (non thermal)	30–100,000	20	1	100
GOST 12.1.006—1988 (Russia)	300–300,000	10	0.25	25
Previous Russian Std (non thermal)	300–3,000	(3.4)	0.03	3
Italian law (Jan 1999) (non thermal)	(30–30,000)	6	(0.095)	(9.5)
Suggested prudent avoidance (non-th)	100–2,500	(2.7)	0.02	2
EN 50082 EU & UK EMC Regulations equipment susceptibility test level	30–1,000	3	(0.027)	(2.7)
Average US (EPA 1980)——>	approx	—	<0.00005	<0.005
City Dweller (FCC 1999)——>	30–300,000		<0.01	<1
"Natural" background "noise"	300–3,000	—	<0.00001	<0.001
Typical maximum at ground near 15m base station masts (can be much higher)	900 & 1,800	3	0.027	2.7
Typical, close to handset antenna	900 & 1,800	100–300	*see note*	*see note*

Note: "Near-field" levels next to a working mobile phone handset vary enormously depending on the antenna design and other parameters but will almost always exceed the electric field and power density levels set in the general exposure standards. Instead of using these standards, attempts are to mathematically model, and also to measure using a "phantom" model head, the likely Specific Absorption Rates (SAR) and these are compared with the basic restrictions in the various standards.

Average SARs from phones are always below the NRPB maximum head SAR 10 W/kg in any 10g sample of tissue; typically 0.3 to 1.5 W/kg, but ranging up to about 6 W/kg in the worst case. The US Standard of 1.6 W/kg in any 1g sample of tissue is amost certaintly exceeded by some mobile phone handsets when operating at full power and held in some positions.

It is not clear that the SAR is the only metric that needs to be specified. It is possible that the high localised electric field levels could be causing the reported headaches, earaches and skin problems. Some phones with low SAR levels have a high number of users reporting headaches, etc.

I gather that the EU Health Ministers have just formally adopted the ICNIRP standard listed above. The NRPB have always advised against the need to adopt these lower levels that are still based on thermal (tissue heating) considerations.

Italy is the only country with non-thermal regulations: Decree No 381 of 10 September 1998, "Regulation laying down standards for the determination of radio frequency ceilings compatible with human health", entered into force on 2 January 1999, and provides for an exposure limit of 6 V/m for broadcast and cellular phone transmitters in respect of buildings in which people live or work for more than four hours per day.

3. Quality and Objectivity of the Advice Provided at Present

3.1 The NRPB is responsible for providing "Advice" on any health implications of electromagnetic fields. Their current position is that there are no serious health effects from microwave levels which are too low to cause tissue heating. Paragraphs 3.5 and 3.6, below, show that this is only a part of a complex story and there are inconsistencies between some NRPB documents and their official "Advice".

3.2 The NRPB Guidance for the general public allows for higher human exposure levels to microwaves than any other regulatory body in the world, even though some of these Standards are also based on thermal considerations *(see Table 1)*. It is interesting to note that while many other bodies have been lowering their public human exposure guidance the current (1993) NRPB Guidance had the effect of significantly increasing the permissible exposure levels compared with their 1988 (GS11) Guidance. This took place around the same time as mobile phones were being introduced.

3.3 Dr John Stather, the NRPB Senior Assistant Director, confirmed their view on BBC2 TV "Money Programme" on Sunday 18 April 1999 with *"if it doesn't heat you, then it doesn't harm you"*. He was followed by Dr David de Pomerai talking about his recent work at Nottingham University where his team had found high levels of heat shock proteins being produced in nematode worms by cellular-phone-levels of microwave exposure. The levels of heat shock proteins, a sign of cell stress, were equivalent to those produced by a three or four degree Celsius rise in temperature even though no rise in temperature from microwaves was measurable. I consider these results to be extremely important as they seem to demonstrate an easy-to-test and very important non-thermal effect. The team is currently repeating the experiments using a different frequency and other institutions should attempt to replicate the work as soon as possible.

3.4 There is an apparent "promotion from within" policy that seems to have operated many times at the NRPB. I believe that this has led, and is still leading, to reductionist and extremely conservative thinking. Many large companies now recognise that bringing "fresh minds" into their organisation at senior levels is important to keep at the leading edge of their field.

3.4.1 The current head of the Non-Ionising Department at the NRPB on leaving school worked for the Scottish Department of Health who sponsored his degree studies. He joined the NRPB not long after it was formed in 1970 and obtained his PhD in experimental radiation dosimetry at Paisley College of Technology. He has now worked for the NRPB for well over a quarter of a century. He has published nothing in the peer-reviewed literature on the biological effects of microwave or radiofrequency radiation. Under oath in the Coghill "Mobile Phones Warning Label" Court case in Wales in November 1998, he repeatedly stated that he only understood dosimetry (the science of measuring signals) and had no understanding of the biological or medical implications of the interaction of electric and magnetic fields with living tissues. He stated that he relied completely on his colleagues for their advice in those areas and refused to venture his own opinion when pressed by the Chairman of the Bench to do so. Yet Dr McKinlay currently represents the NRPB and, effectively, the United Kingdom, on most of the European and International Committees on Non-Ionising Radiation Protection.

3.5 In 1996 the European Commission set up an Expert Group mandated to draw up a blueprint for research into possible health effects relating to the use of mobile telephony. Dr McKinlay (NRPB) Chaired this group which reported to the EC at the end of September 1996. Their report called for funding of further research. On page three of the Report, under the heading "Health concerns", we find:

> *"Public concern about the health hazards of electromagnetic fields from radio-telephones has increased. Specifically, there is concern that, as the handsets deployed in the new generation of personal*

telecommunications systems are brought close to the head, there may be either a thermal insult produced by power deposition in tissue (acute effect) or other (long-term) effects."

. . . *"A large body of literature exists on the biological effects of radiofrequency and microwave radiation . . . Overall . . . while providing useful information, [it] provides no convincing evidence that the use of radiotelephones, whether analogue or digital, poses a long-term public health hazard . . .*

. . . Microwave radiation absorption occurs at the molecular, cellular, tissue and whole-body levels"

. . . "A substantial body of data exists describing biological responses to amplitude-modulated radiofrequency (including microwave) fields at SARs too low to involve any response to heating. It has been suggested that non-equilibrium processes are significant in the bioenergetics of living systems, challenging the traditional approach of equilibrium thermodynamics. . . ."

3.6 Other, not so Accessible, NRPB Literature

"Biological Effects of Time Varying Electromagnetic Fields" is an internal document written by Dr Zenon Sienkiewicz for the NRPB Training Section. [1] This includes (on page 5):

"There are in addition a large number of biological effects that have been reported in cell cultures and in animals, often in reponse to relatively low field levels, which are not well established but which may have health implications and are the subject of much ongoing research."

"These include research on the effects of ELF fields on the body's daily (circadian) rhythms and on growth and development of the embryo and foetus, on the effects of ELF fields and RF radiation on carcinogenic processes, on the existence of specific frequency and amplitude 'window' effects, and on effects of low level pulsed RF radiation."

[eg GSM digital mobile phone radiation—my comment and underlining]

. . . "The possibility that only certain combinations (windows) of EMF frequency and amplitude could elicit biological effects has been reported in studies in which exposure to very low levels of amplitude modulated RF radiation, too low to involve heating, altered the brain activity in cats and rabbits, the activity of an enzyme involved in tumour promotion, and to affect calcium ion mobility in brain tissue in vitro and in vivo." . . .

. . . "Recent well-conducted studies by one group of research workers suggest that the retina, iris and corneal endothelium of primate eyes are susceptible to low-level microwave irradiation, particularly to pulsed radiation. Various degenerative changes, particularly of the light-sensitive cells in the retina, have been reported." . . .

. . . "Exposure to low levels of pulsed or continuous wave RF or microwave radiation have been reported to affect neurotransmitter metabolism and the concentration of receptors involved in stress and anxiety responses in different parts of the rat brain."

3.7 On the evidence acknowledged by the NRPB alone, summarised in 3.5 and 3.6 above, I hold the view that the responsible action would be to apply the precautionary principle and at least affix warning labels to mobile phones.

3.8 Neither the NRPB nor its Advisory Group on Non-Ionising Radiation (AGNIR) have published critiques of most of the scientific literature on this issue which has been published since the original Doll Report (NRPB Vol 3 No 1, 1992). They issued a brief and incomplete update statement (dated 12th April 1994) in the back of NRPB Docs Vol. 5 No. 2. 1994. Since then, all the NRPB has issued are occasional press statements about specific selected pieces of published research. Even though they are promising a new report by AGNIR by the end 1999, given the large number of relevant scientific reports which have been published in the last five years, the lack of published assessments is an anomaly for a publicly accountable body.

3.9 In the Doll Report they made little attempt to sort the "good" studies from those with admitted "flaws" which diluted the significance of any real effects. The NRPB also chooses not to include some peer-reviewed published studies in its literature reviews. I do not believe that ignoring studies without setting out credible scientific justification is appropriate.

In the late 1950s and early 1960s Sir Richard made the mistake of both publicly ignoring and trying to block publication of Dr Alice Stewart's work on the dangers of x-raying pregnant women. Now it is accepted that her study conclusions were both important and correct.

3.10 I have repeatedly requested that the NRPB examines a number of ill mobile phone users who have contacted me claiming adverse health problems. It seems to me that their examination and testing might shed some light on what is happening. However, the NRPB refuses to examine such people "in case they try to claim compensation as the NRPB is not prepared to be a witness in any litigation". They also refuse to arrange and pay for such testing to be done by a third party expert. It is not clear what Government body has the remit to help resolve these issues for consumers.

3.11 Professor Roger Clarke, in his verbal evidence to this committee on 9 June 1999, is reported as saying "I think that sometimes, if I understand the physics of the mobile telephone correctly, if you shield it and reduce its ability to connect with base stations, it is liable to make up its own mind to increase its power level and end up with the same exposure as before".

It appears that the NRPB has not really got a good understanding of what occurs in practice. Roger Clarke's statement is almost the same as many industry statements dismissing these "screening cases" and it seems that he is speaking from theoretical considerations and "industry say-so" and that the NRPB has not obtained and carried out detailed tests on such a case before passing comment.

His remark is mostly relevant to a product called "Microshield" which works by sliding a spring metal strip up the side of the antenna and this does, indeed, make the phone increase its power. A standard GSM handset can control its peak output power in 12 steps from 2 Watts down to 8 mW.

However, the Microshield case has been tested by many independent laboratories including ones in the UK, Russia and Australia and has been found to significantly reduce the Specific Absorbed Radiation (SAR) level in a phantom human head. The latest two laboratories in the UK that have tested it are BT Mobile (an industry lab) and the National Physical Laboratory (in two separate sets of tests paid for by the BBC and by the Sunday Mirror). The NRPB approved the protocol of the NPL tests paid for by the BBC and were sent the results in February 1999. The NPL found that while the Microshield case reduced the radiation by up to 90 per cent when the phone was already operating at full power, even in the "worst case" when the phone increased its power from originally operating at a low level it still reduced the final SAR in the meningeal layer of the phantom head by about 25 per cent.

3.12 The NRPB has not been prepared to enter into any meaningful dialogue with me regarding any scientific matters where we hold differing views. If I am to be on site as an observer they now even refuse to take ambient microwave level measurements that clients are paying for. Last Autumn there was a scientific meeting of the WHO EMF Project on future EMF Metrics which was held at the NRPB. About 45 people, including industry representatives and a number of researchers who had not got any EMF related research experience were invited. I repeatedly asked Drs McKinlay and Stather if I could attend and they refused. I then contacted Dr Mike Repacholi, Head of the WHO project, and received the following reply: "There will be further meetings without the restrictions placed on the NRPB meeting that will allow you to provide your input. I have asked my secretary to place you on our mailing list for future meetings. Yours sincerely, Mike Repacholi."

3.13 Directly after the Coghill warning label court case last November I asked Dr Mike Clark, the usual NRPB public spokesman, why they did not produce a couple of sides of A4 describing the reported mobile phone health problems in a very factual and questioning way. He answered me: "We are instructed not to admit to any adverse effects." Who is giving this instruction?

3.14 The Parliamentary Office of Science and Technology POST note 109, "Health Risks and Mobile Phones", dated January 1998 is more informative than many NRPB public documents.

4. Assessment of Current Procedures for Obtaining Good Quality Scientific Advice

4.1 I am aware of the work of the NRPB organisation and COMARE. In the UK the NRPB has the responsibility for advising Government on the possible adverse health effects of both ionising and non-ionising radiation. Using this advice, the Health and Safety Executive (HSE) is responsible, with the Secretary of State for Health and the Government, for proposing and enacting safety legislation.

4.2 I believe that these orgnisations should be instructed to include the precautionary principle in coming to a decision on what to include in their "Advice".

4.3 I question the cost-effectiveness of the public funding of the NRPB's current organisational structure. Currently they are doing virtually no practical EMF bio-exposure work at all. This would not necessarily matter if they were actively involved in practical ways with good research at European Universities, but they are not. I suggest consideration is given to creating a number of (funded) senior leading scientific research positions to which leading scientists in the field from around the world could be seconded for specific projects lasting from one to three years. I believe this would lead to much more up to date thinking and stimulate the practice of good science.

4.4 Both the main NRPB Board and their Advisory Groups should be required to have members specifically with Consumer and Trade Union Health and Safety backgrounds.

5. The Processes for Assessing Scientific Advice in Policy Making and Regulation

5.1 At present the NRPB filters scientific research and does not publicly acknowledge the potential implications of research which show effects other than thermal ones. This refusal to incorporate the precautionary principle in its advice means that the Department of Health and the Health and Safety Executive are not in possession of the full picture. This then means that they have insufficient information to know how to, and when it would be appropriate to, apply the precautionary principle.

5.2 A recent DETR/DH draft Joint Circular 99: Land Use Planning and Electromagnetic Fields was circulated to councils for comment in December 1998. This document was primarily drafted at the Department of Health by NRPB's Philip Chadwick who had been seconded to them part time for the previous couple of years. His authorship is not acknowledged and Circular 99 in no way represents a precautionary stance.

5.3 It was circulated by the DETR who also enclosed "a copy of a briefing document on EMFs prepared by the World Health Organisation (WHO). They have kindly agreed to our sending this advance copy to assist consultees in their consideration of the draft circular." The WHO draft document was prepared by Philip Chadwick and Zenon Sienkiewicz and this was stated on it. What was not stated, however, was that they are both members of staff of the UK NRPB and the draft had had little consideration by other countries who are members of WHO. It does not take a precautionary stance and basically sets out the standard NRPB viewpoint.

5.4 I, among many others, prepared responses to both documents, neither of which incorporated the precautionary principle. On two occasions I have asked how the formal consideration of the various submitted comments would be done and if there would be a reply to points raised. The only reply I had from the DETR was: We are currently considering the responses received. You may be intererested to note that all responses to the draft circular (other than those made on a confidential basis) have been placed in the DETR library". That was not an answer to my question asking how the points in the responses would be considered.

5.5 Talking to Local Government Association officers, I now gather that comments are often apparently ignored and it is usually left to the original authors to read the responses and to chose whether, or not, to incorporate any of them into the final document. This does not leave an adequate audit trail of the decision making process and seems to make a nonsense of the consultation process.

5.6 There needs to be a new forum for assessing controversial science, including that regarding mobile phones and health. The Court of Law are not appropriate and the NRPB system is effectively closed to outside dissenting voices. The NRPB do not need to publicly debate the reasons for holding their view. The DH and DETR systems do not seem to incorporate adequate safeguards for checking that concerns raised in the responses to draft consultation documents are adequately addressed.

6. The Extent to Which There are Grounds for Health Concerns

6.1 I could easily write a long memorandum on this subject alone but I will restrict myself here to a few more points, leaving detailed considerations for the new "expert group" which is now being set up.

6.2 I have now talked to several thousand members of the general public who believe that mobile phone use has caused them adverse health problems ranging from merely irritating to extremely serious. They report headaches, loss of concentration, skin tingling or burning, twitching, eye tics, very poor short-term memory, buzzing in their head at night, and other less common effects. Headaches often come first and/or skin effects. Then concentration and short-term memory tends to deteriorate. Initially it can be missing an intended turning off a motorway or forgetting appointments. At first, learning or remembering NEW facts, similar to early signs of dementia, are experienced. Users also report headaches and excessive tiredness. Many reports are from engineers who use their phones extensively and were very sceptical of EMF adverse health effects until they started to experience them.

6.3 These reports are similar to those reported by Mild *et al,* National Institute for Working Life, Sweden [2]. They analysed responses from around 12,000 mobile phone users in Sweden and Norway. Although not a main design hypothesis of their study, their Summary includes finding: "a statistically significant association between calling time/number of calls per day and the prevalence of warmth behind/around or on the ear, headaches and fatigue". Their reference categories were mobile phone users who used their phone less than two minutes or two calls per day and they found dose/response relationships with concentration, memory loss, fatigue and headache. Statistically significant Odds Ratios rise to 4.74 (2.19–10.3) for fatigue and 7.00 (2.68–18.3) for headaches (95 per cent confidence limits) for people who used the phones for over one hour per day total. Memory loss and fatigue ORs were generally between two and three for this group of users.

Overall, my assessment of their data is that about one in 10 of users are likely to experience significant subjective effects with extended use and maybe around another 15 per cent some apparent adverse effects. Maybe around 75 per cent of the population can use a mobile phone fairly extensively without experiencing these effects to any significant degree. There are currently around 15 million UK mobile phone users. If about a third of these use their phones regularly then the health and performance of between 0.5 and one million people may adversely be affected by their mobile phone use.

6.4 Looking at a more serious outcome, namely cancer, there are a number of studies which indicate we should be adopting a very precautionary approach in these matters. I will mention only a couple. Back in the early 1980s Sam Milham, in the USA, reported excess leukaemias among amateur radio operators, with deaths from acute and chronic myeloid leukaemias nearly three times higher than expected. Then in the mid-1980s Stanlislaw Szmigielski reported that Polish military personnel exposed to RF energy showed elevated leukaemia levels. He published a 1996 update [3]. This is a study of all Polish military personnel for 15 years (1971–85), approximately 128,000 people each year. Of these about 3,700 (3 per cent) were considered to be occupationally exposed to microwave radiation. The largest increases were found for chronic myelocytic leukaemia (CML), with an astounding Odds Ratio increase of 13.9 (95 per cent CI 6.72–22.12, $p < 0.001$), acute myeloblastic leukaemia (AML) with an OR of 8.62 (95 per cent CI 3.54–13.67, $p < 0.001$), and non-Hodgkin's lymphomas with an OR of 5.82 (95 per cent CI 3.54–13.67, $p < 0.001$).

NHL is one of the cancers whose incidence in the UK is currently increasing for no known reason.

The highly exposed category that produced the above ORs were estimated to have time averaged exposures in the range 2 to 6 $\mu W/cm^2$ with a workday mean around 10 $\mu W/cm^2$. The reasons that these exposure levels were so low is that, at the time, the Polish unrestricted exposure standard was set at 10 $\mu W/cm^2$ with a work-shift maximum of 200 $\mu W/cm^2$ apart from time limited "hazardous" exposure for authorised personnel of 4,400 $\mu W/cm^2$ for one minute and 10,000 $\mu W/cm^2$ for only 20 seconds.

It is interesting to note that the current NRPB "Advice" allows unlimited public exposure to levels up to 10,000 $\mu W/cm^2$ at frequencies above 1,550 MHz.

6.5 Swiss Re is one of the largest re-insurance companies in the world. Part of their survival strategy is to look into the future to predict potential large liabilities and they have determined that EMF litigation is one such area. They published a report on the subject in late 1996, called "Electrosmog—a phantom risk" [4]. In my opinion it is a landmark publication and contains much debate that is missing from official UK documents on the possible risks of EMFs. I extract a few key paragraphs, some slightly paraphrased for brevity.

> "Generally it is expected that the question as to whether electromagnetic fields and radiation pose a health risk will be answered sooner or later with a clear Yes or No, which would then more or less automatically clarify the question of legal liability. This expectation is erroneous because it is based on a mistaken assumption: namely, that the relationships between EMF exposure and diseases such as cancer, immune deficiency, Alzheimer's Disease and Parkinson's Disease are merely complicated. In fact, however, we are dealing with complex relationships which cannot even be identified, let alone understood, using the research methods presently available. . . . . . . The only reliable answer to "do EMFs impair health?" is "Perhaps".
>
> "With only inconclusive findings to go on we find ourselves facing the task of trying to achieve a just balance between the individual's need for protection and the interests of society as a whole—a technology that benefits many but may possibly seriously harm some few." . . .
>
> ". . . a relationship that is especially important for gaining a correct understanding of the EMF issue is that living organisms can amplify the energy of signals. The actual cause of the biological response is this amplification process, not the signal itself which "merely" triggers it. It is therefore necessary to distinguish between energy effects and signal effects and two different dangers posed by electromagnetic phenomena."
>
> . . . "Up until the beginning of this century, science was able to study only questions which could be answered with Yes or No. In the course of this century, it has become ever more apparent that practically all causal laws are, in reality, mere statistical observations. . . . At first glance, there is only a minor quantitative distinction between 'certain' and 'highly probable'. In fact, however, the difference is fundamental and qualitative because it is the difference between 'must' and 'can', between 'yes/no' and 'perhaps', between 'doubtful' and 'doubtless', between 'certain' and 'uncertain', between 'possible' and 'impossible'. It is the difference between 'knowledge' and 'conjecture'. And because all scientific knowledge is based on statistical observations, the knowledge of science is mere presumptive knowledge. . . . This change of paradigm, which was initiated early in this century through the insights of nuclear physics and is now starting to take concrete form in new scientific disciplines such as complexity research, has been accompanied by a fundamental change in the concept of causality." *"While classical science is considered a cause to be only that which must necessarily bring about an effect as a result of the causal principle, today a cause is also considered to be that which may bring about an effect*. The possibility that electromagnetic exposure might favour the incidence of certain diseases cannot be excluded. According to our present understanding, electromagnetic fields would then be a cause of disease just like a flu virus which may, but need not necessarily, result in influenza."
>
> "The socio-political risk must be classed as extraordinarily high because the legal instrument of liability is increasingly being used, or even misused, as a means of coping with the problems of life. But who decides what is right and what is wrong, what is detrimental and what is beneficial, what is to be permitted and what is to be prohibited? Natural science denies responsibility, and politics proves to be unequal to the task of bringing about a social consensus on what risks people are willing to enter into conjointly, and what share of these risks each individual must bear."
>
> . . . "The EMF problem cannot be resolved through further research alone: on the contrary, there is a need for new, practice-oriented categories for assessing the research results currently available. . . . The EMF problem cannot be delegated to individual groups or institutions: that would be like leaving the formulation of a contract to just one of the parties. . . . It is not acceptable to force risks upon individual human beings; neither is it in the interest of the general public to dispense with technological opportunity that might benefit the many because of the possibility that some individuals might suffer harm. What is required is a consensus on how much risk individuals may reasonably be expected to accept."

7. The Opportunities for New Technologies to Reduce Health Risks

7.1 All the major manufacturers have been patenting new designs which reduce the amount of radiation absorbed by the user's head. Various methods are being used.

7.2 The 2nd generation digital systems chosen by Europe (GSM/PCN/DCS) use a Time Domain Multiplexed Access (TDMA) approach which results in bursts of microwave radiation from the handset with relatively long gaps (one slot in eight is transmitted at a basic repetition rate of 217 Hz). Pulsed microwaves have been shown to be more biologically active than continuous radiation of the same frequency and power level. Up to 80 per cent of the transmitted power can be absorbed by the user's head, which means that their brain cells are being "hit" by these radiation pulses 217 times every second. The NRPB, and others, average the power from a digital phone over one second, and so divide the pulse power by eight. They correctly argue that the tissue has time to cool down between pulses, but then go on to deduce that no damage will therefore take place. This is similar to saying that placing a hammer on a "cell" (an egg, for example) exerting a small steady force, will produce the same effect as hitting the egg, using eight times the force briefly once a second. As most practical engineers know, when trying to loosen a stuck nut and bolt, the *effect* of constant pressure on the spanner is far less than when tapping the spanner with a hammer.

In addition, GSM digital phones and the new DECT cordless phones also put high levels of low frequency magnetic fields, due to the battery current surges, into the user's head (from about 0.5 to 5 microtesla [μT]. Concerns about ELF magnetic fields and childhood leukaemia start at levels from less than 0.5 μT, and the effect on cellular growth control enzyme ornithine decarboxylase [ODC] has been shown to double in activity by about 1.2 μT. These low frequency magnetic fields may be more responsible for the dementia (memory) effects than the pulsed microwaves. The NRPB has not investigated, or commented on, this aspect of mobile phone fields.

7.3 The newer American Code Domain Multiple Access (CDMA) system works differently and does not emit the sharp-edged low frequency magnetic pulses nor the short bursts of microwaves. The digital RF signal resembles a noisy analogue signal and is also likely to be less bio-active. The third generation European UTMS system incorporates CDMA and should expose the users to lower and less biologically active fields provided that it really does not use the TDMA bursts from handsets.

8. The Need for Further Research

8.1 There is a clearly identified agreed need for further research, that the WHO EMF Project is attempting to address.

8.2 There is clear evidence that the Mobile Manufacturers Forum (MMF) is trying to control where research funding is allocated and for which projects. Led by Motorola, in Summer 1998 they set up a "Research Planning Committee" in order to influence the selection which laboratories would be allowed funding for collaborative mobile-phone health related research. This seems an unacceptable and restrictive practice. I believe Dr Preece will address this in his Memorandum.

8.3 There are a number of types of electromagnetic field emitted by a mobile phone handset and all these have a number frequency components. These make the issue complicated to research. The phones emit microwaves, which in the case of European digital phones are emitted as short bursts lasting about 0.5 milliseconds (ms) every 4.6 ms, ie 217 times every second. Thus the peak power into the user's head is eight times the average power. The average power is what causes the heating and is measured as an SAR (see 3.11) in watts per kg of body tissue. The NRPB and CENELEC average the temperature rise over 10g of tissue whereas the ANSI/IEEE standard uses a more critical 1g which means that the ANSI SAR induced in head tissue by given 1,800 MHz microwave signal is about twice the value of the NRPB SAR in a 10g sample. To complicate matters further, phone handsets transmitting at nominally the same power induce SARs in head tissue over approximately a 6:1 ratio; the most efficient only "wasting" about 13 per cent of their energy into the user's head while for the least efficient about 80 per cent of their total transmitted energy is absorbed by the head. [5] shows the results of testing 19 different handset models.

The head is in what is called the "near-field" of the phone where there is a variable relationship between the electric and magnetic components of the microwaves. The electric component can be over 300 volts/metre and impinges on the skin, triggering skin and nerve reactions. The magnetic component passes through the skull and induces currents to flow and SAR heating in the meninges and brain tissue. Phones with stubby (non-extending) antennas generally produce higher magnetic near-fields and phones with an extended antenna higher electric near-fields.

The UK digital phones also produce real low frequency magnetic fields (see 7.2 above). Both the microwave and low frequency pulses have the 217 Hz (plus harmonics), and also 32, eight and two Hz components mainly due to discontinuous transmission (DTX). It is possible that these lower frequency signals might interfere with normal brain function activity.

The GSM system continuously adjusts the transmit power of the handset over a ratio of up to 250:1 in order to use the minimum necessary to maintain the call. This means that two users making identical calls from identical handsets can experience a 250-fold difference in power level due to their physical location. This will make epidemiological studies extremely hard to analyse.

The two main American digital systems are sufficiently different technically to be likely to have quite different biological interactions from the GSM system. The forthcoming Iridium satellite phones use TDMA, like the GSM system, but pulse at around 11 Hz and so may have further differences. It is easy, with this plethora of different transmission techniques and frequencies, to miss discovering important associations that are taking place for only some systems. It will certainly reduce the usefulness of any meta-analyses.

REFERENCES:

(1) *"Biological Effects of Time Varying Electromagnetic Fields"* Z J Sienkiewicz, . . .NRPB.

This was handed out at an NRPB Awareness Course on EMFs and Human Health on 26 November 1997 *I enclose a photocopy* (10 pages) as I do not believe the document is generally available.[6]

(2) *"Comparison of symptoms experienced by users of analogue and digital mobile phones"* (70 pages) Mild, *et al,* National Institute of Working Life, Sweden. Arbetslivsrapport ISSN 1401-2928.

(3) *"Cancer morbidity in subjects occupationally exposed to microwave electromagnetic radiation"* S Szmigielski, The Science of the Total Environment 180, 1996, pp 9-17, Elsevier.

(4) *"Electrosmog—a phantom risk",* Christian Brauner, published by Swiss Re, 1996.

(5) Histogram from a talk at *"Mobile Phones—is there a health risk"* IBC Conference 14th October 1998 by Dr Neils Kuster, Swiss Federal Institute of Technology, Switzerland.

6 June 1999

Annex 1

BIOLOGICAL EFFECTS OF TIME VARYING ELECTROMAGNETIC FIELDS

Z J SIENKIEWICZ

ABSTRACT

Acute exposure to extremely low frequency electric and magnetic fields of sufficient field strength or flux density will result in the perception of surface charge (electric fields only) and in the induction of electrical potentials and currents in the body which will affect electrically excitable tissue such as nerves and muscles. Acute exposure to sufficiently intense radiofrequency and microwave radiation will induce heating, resulting either in detectable rises in tissue or body temperature or in responses for minimising the total heat load. Except for the perception of surface charge, fields of the magnitude necessary to induce these responses are unlikely to be encountered except in a few occupational or medical situations.

The effects described above are well understood. However, the vast majority of people are exposed to much lower field strengths. There are several possible areas of biological interaction at low levels of exposure which may have important health implications and about which our knowledge is limited. Mechanisms of interaction have been proposed but are not established. If there are such effects, then the evidence suggests that they are subtle and may well be masked by normal biological variation.

INTRODUCTION

An extensive and diverse literature has arisen during the last two decades in which a wide variety of biological effects and responses have been attributed to exposure to electromagnetic fields. Many of these effects are known to result from the induction of surface electric charge, induced electric fields and currents within the body, or from increases in thermal loading and elevated body and tissue temperature. These particular effects and responses are well-understood and have been used by various national and international organizations as scientific bases in setting guidelines and restrictions on exposure to electromagnetic fields for human populations (eg INIRC, 1988; Allen et al, 1991; NRPB, 1993). In addition, a variety of biological responses, including a possible adverse effect on pregnancy outcome and increased risk of certain types of cancer have been reported at very low levels of exposure which appear to defy conventional explanation, as the induced fields will be so minute that they will be completely masked by thermally generated electrical noise. Possible interaction mechanisms have been suggested but none have been established experimentally in vivo.

In these lecture notes, the biological effects are discussed under three separate sections. The first section describes the well-established effects of exposure to fields with frequencies less than 100 kHz on the nervous system. The second section considers the biological effects of whole body and localised heating following exposure to RF and microwave radiation at frequencies above 100 kHz. The third section describes biological effects that are less well established, and includes effects on embryo and fetal development and cancer-related studies.

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[6] Annex 1.

The information summarised in these notes is covered in more detail in NRPB, (1993), Sienkiewicz et al (1993), NRPB (1994), and Cridland et al (1996). Other reviews describing the general biological effects of electromagnetic fields and radiations are listed at the end of this chapter. The specific effects of electromagnetic fields on cells and cellular systems have recently been reviewed by Cridland (1993).

ELECTRIC AND MAGNETIC FIELDS OF FREQUENCIES OF LESS THAN 100 KHZ

Extremely low frequency (ELF) electric fields external to the body induce electric fields and currents within the body as a result of the time-variation of the induced surface charge density; the induced current density in general increases as the body cross section decreases and depends on the electrical properties of tissue. ELF magnetic fields induce circulating electric currents in such a way that the largest current densities tend to be induced in peripheral tissues, decreasing in magnitude towards the centre of the body.

Surface electric charge

Exposure to time-varying electric fields can result in perception effects due to the alternating electrical charge induced on the surface of the body. The perception results from the surface electrical charge causing, for example, body hairs to vibrate, and may become stressful if prolonged. About 10 per cent of adults can perceive power frequency electric fields of 10 to 15 kVm^{-1}; the threshold for annoyance is around 15 to 20 kVm^{-1}.

Nervous system responses

It is well established that electric currents applied directly to the body can stimulate peripheral nerve and muscle tissue, and such effects can prove fatal if breathing is inhibited or ventricular fibrillation induced. Threshold current densities for direct nerve or muscle stimulation are thought to be about 1-10 A m^{-2} between 10-1,000 Hz, rising progressively at frequencies above and below this range. Similarly, the exposure of volunteers to rapidly alternating (1 kHz) gradient magnetic fields in experimental magnetic resonance imaging systems has been shown to elicit nerve and muscle stimulation. In addition, short, rapidly changing magnetic field pulses have been used to stimulate nerves in a number of clinical studies.

Current densities at levels insufficient to stimulate excitable tissue directly may nevertheless affect ongoing electrical activity and influence neuronal excitability. The activity of parts of the central nervous system such as the spinal cord, the cerebellum and the cortex are known to be sensitive to the endogenous electrical fields generated by the action of adjacent nerve cells at levels below those required for direct stimulation. Neurophysiological studies of isolated nervous tissues suggest that threshold current densities may be as low as 100 mA m^{-2}. However, even lower thresholds can be derived from studies of weak field effects on volunteers, perhaps reflecting the increased sensitivity of the intact organism compared to responses from isolated tissue. A large number of studies have reported volunteers experiencing faint flickering visual sensations—the magnetic phosphenes—during exposure to ELF magnetic fields above about 5 mT. These can also be induced by the direct application of weak electric currents to the head with threshold current densities of about 10-20 mA m^{-2}. These results suggest a conservative estimate of 10 mA m^{-2} for the current density threshold for modulation of neuronal activity in the central nervous system. This value receives some support from a study of the effect of weak power frequency electric currents on human mental processes. Volunteers had electrodes attached to their head and shoulders through which weak electric currents were passed (current densities in the brain were estimated as around 10–40 mA m^{-2}) and were required to perform a number of reasoning tasks whilst either exposed or sham exposed. The performance of most tasks was unaffected, but some changes were seen in alertness and the performance of a complex reasoning task. Unfortunately, the design of the study made it difficult to draw any definite conclusion.

Field-induced changes in neuronal excitability within the central nervous system could be responsible for producing observable changes in behaviour. However, exposure of rodents or non-human primates to 60 Hz electric fields of up to 30 kV m^{-1} does not appear to reduce the performance of learned tasks. Other effects on behaviour observed during exposure of animals to an electric field, such as transitory changes in arousal or activity in rodents, or in the social behaviour of baboons are more likely the result of stress caused by perception of the field by cutaneous stimulation. Similarly, exposure of rodents to magnetic fields does not cause long-term changes in behaviour, although some studies suggest transient changes in the performance of specific learning tasks with fields of about 1 mT.

Exposure has also been reported to result in mild changes in cardiac function in human volunteers; the resting heart rate was found to be slightly reduced (by about 3-5 beats per minute, well within normal values) during or immediately after exposure for 2-6 h to power frequency electric and magnetic fields of 9 kV m^{-1} and 20 μT, but not after exposure to stronger or weaker fields. The small magnitude and transitory nature of this effect, however, does not suggest a health risk.

RADIOFREQUENCY AND MICROWAVE RADIATION OF FREQUENCIES ABOVE 100 kHz

The heating effects of radiofrequency (RF) and microwave radiation are well established; the total whole body heat load experience during RF exposure is the sum of the SAR and the endogenous rate of heat production. The latter varies in normal individuals from about 1 W kg^{-1} at rest, to about 10 W kg^{-1} for short periods during hard physical exercise. Power deposition within the body is never uniform; differences in the electrical properties of tissues and the reflection and refraction of radiation at the interfaces of tissues of different electrical properties can result in localised SAR "hot spots". In addition, differences in local blood perfusion will affect heat dissipation characteristics, and some tissues are more sensitive to raised temperatures than others, and/or may be less able to effect repair.

Whole-body responses

Animals, like humans, use various physiological and behavioural mechanisms in order to regulate body temperature. The responses of the thermoregulatory system to irradiation are well established and include altered rates of metabolic heat production, food intake, activity, the vasodilation of superficial blood vessels and the behavioural selection of appropriate ambient temperatures. Thresholds for such responses have been reported in rodents and primates between about 0.3 W kg^{-1} and 5 W kg^{-1}. The magnitudes of these responses appear to depend on the frequency of irradiation used, and orientation of the exposed animal with respect to the applied electric and magnetic field. These are caused by differences in power absorption by the deeper tissues of the body; in particular, the less effective stimulation of the temperature receptors in the skin results in less effective thermoregulation.

The performance of learned tasks seems particularly sensitive to RF radiation; thresholds for decreased performance in both rats and primates have been reported as lying between 2.5 and 8 W kg^{-1}; concomitant rises in rectal temperature were around 1°C. Exposure to RF radiation can also modify the action of drugs whose effectiveness can be altered by heat-induced changes in body physiology; changes have been recorded in the duration of barbiturate-induced anaesthesia and in the permeability of the blood-brain barrier, but only at levels of irradiation sufficient to raise body temperature.

Other easily demonstrable effects are generally consistent with responses to non-specific stressors such as heat. The acute exposure of primates to microwaves or RF at SARs of 3 to 4 W kg^{-1}, sufficient to raise rectal temperature by 1 to 2°C, resulted in increased stress hormone (plasma cortisol) levels; similar effects have been reported in rats. In addition, microwave-induced changes have been reported in the levels of circulating white blood cells (increased levels of neutrophils and decreased lymphocyte levels) in rats and mice following thermal exposures which are similar to the changes induced by the injection of stress hormones, suggesting a common aetiology. Reported changes in white blood cells (natural killer cell and macrophage) activity have also been linked to heat induced stress.

Similar sorts of changes could be expected in humans following RF-induced increases in body temperature. It is known that most healthy people can tolerate short-term rises in body temperature by up to about 1°C, although individuals vary widely in their ability to tolerate increased body temperatures; some individuals cannot tolerate rectal temperatures of 38°C, others continue to perform well even at higher temperatures. However, prolonged exposure at body temperatures in excess of 38°C is known to increase the risk of heat exhaustion and reduce mental performance. Experiments have been carried out with volunteers which investigated the relationship between whole body SAR, body temperature rise and the ensuing physiological responses. One study reported that following exposure to RF magnetic fields at a whole body SAR of 3 W kg^{-1} for 20 minutes, body temperature was increased by up to 0.7°C without having stabilised and the resting heart rate was elevated by up to 45 per cent. The total heat load experienced by the volunteers, resulting from the sum of the SAR and metabolic heat production, can be estimated as about 5 W kg^{-1}, which represents a typical heavy workload for many industrial jobs. Adverse environmental conditions and moderate physical exercise will reduce the tolerable level of RF or microwave energy absorption, whilst people under medication or with clinical conditions which compromise thermoregulation may be more sensitive to RF or microwave induced heating.

Localised responses

The lens of the eye is regarded as potentially sensitive to microwave irradiation because of its lack of a blood supply and consequent limited cooling ability, and its tendency to accumulate damage and cellular debris. In anaesthetized rabbits, high local temperatures induced by acute exposure of the head to microwave radiation between about 1 and 10 GHz have been shown to induce lens opacities (cataracts); the threshold SAR in the lens was between about 100 to 140 W kg^{-1}. Primate eyes were found to be less susceptible to cataract induction, possibly because they are more recessed in the skull, and so better shielded, and have thinner lenses which can dissipate heat more effectively. However, thresholds for chronic exposure have not been defined. In humans, cataracts have been historically associated with chronic exposure to infrared radiation, indicating that some degree of caution should be exercised.

Testicular temperatures are normally several degrees centigrade below body temperature, and it has been known for some time that male germ cells are sensitive to elevated testicular temperatures. Two animal studies have reported that chronic exposure at about 6 W kg^{-1} may have resulted in transient infertility in male rats. In one study, body temperature rose by about 1.5°C during exposure. In the other study, testicular temperature rose to about 37.5°C, a rise of about 3.5°C which was considered to be the minimum exposure required to cause a slight loss of male fertility in rats. In humans, it has been reported that repeated heating of the testis by 3-5°C will result in a decreased sperm count persisting for several weeks.

Heat has been shown to be teratogenic in various animal species including primates and has been associated with central nervous system and facial defects in children whose mothers developed moderate to severe hyperthermia, especially during the first trimester of pregnancy. The embryo and fetus may be particularly sensitive to RF-induced heating, since heat loss across the placenta will be less effective than heat exchange in other, well vascularised tissues. In rats, acute exposure at 11 W kg^{-1}, raising maternal temperatures to 43°C, was sufficient to induce embryo and fetal death and developmental abnormalities; chronic exposure at 6 to 7 W kg^{-1}, usually raising maternal temperatures to between 39 and 41°C, was reported to induce growth retardation and subtle behavioural changes. In general, even prolonged exposure at less than 4 W kg^{-1} had no effect.

Surface heating

The absorption of RF and microwave radiation can be detected by temperature sensitive receptors in the skin. Power flux densities of around 300 W m^{-2} at 3 GHz have been detected experimentally during exposure for 10 seconds; radiation of higher frequencies applied for similar lengths of time have been detected at lower power flux densities because of their greater absorption by the skin. It is considered that the avoidance of the perception of skin warming for frequencies where the penetration depth is greater than the thickness of the skin (ie frequencies below about 10 GHz) does not provide a reliable mechanism of protection against potentially harmful exposure. The avoidance of the perception of skin warming may give adequate protection at frequencies above 10 GHz, although its general effectiveness may be reduced if other factors in the environment compete for attention.

Pulsed radiation

People with normal hearing have perceived pulse-modulated RF radiation of frequencies between about 200 MHz and 6.5 GHz; the sound has been variously described as a buzzing, clicking, hissing or popping noise, depending on modulation characteristics. Prolonged or repeated exposure may be stressful. It seems most likely that the sound results from the thermoelastic expansion of brain tissue following a small but rapid increase in temperature on the absorption of the incident energy. The perception threshold for pulses shorter than 30 µs depends on the energy density per pulse and has been estimated as about 400 mJ m^{-2} at 2.45 GHz, corresponding to an estimated specific energy absorption in the head of about 16 mJ kg^{-1}. However, a reduction in ambient noise has been reported to reduce this to about 280 mJ m^{-2}, an SA of 10 mJ kg^{-1} at 2.45 GHz.

Exposure to very intense pulsed radiation has been reported to suppress the startle response and evoke body movements in conscious mice. Specific absorptions were 200 mJ kg^{-1} [for 1 µs pulses] and 200 J kg^{-1} [for 10 µs pulses] for suppression of the startle response and evoked body movement respectively. The mechanism for these effects is not well established although they may well be related to microwave hearing; auditory thresholds for rats are several orders of magnitude lower, about 1-2 mJ kg^{-1} per pulse ($<$30 µs) for rats.

POSSIBLE EFFECTS OF TIME VARYING ELECTROMAGNETIC FIELD EXPOSURE

The effects of exposure to time-varying electromagnetic fields (EMFs) that have been described so far are well established and fairly well understood. There are in addition a large number of biological effects that have been reported in cell cultures and in animals, often in response to relatively low field levels, which are not well established but which may have health implications and are subject of much ongoing research. These include research on the effects of ELF fields on the body's daily (circadian) rhythms and on growth and development of the embryo and fetus, on the effects of ELF fields and RF radiation on carcinogenic processes, on the existence of specific frequency and amplitude "window" effects, and on the effects of low level pulsed RF radiation. Studies on the possible effects on embryo and fetal growth and development, and on carcinogenic processes can be linked to epidemiological studies of pregnancy outcome and the risk of cancer.

Circadian rhythms and melatonin secretion

Some evidence has been published to suggest that chronic exposure to ELF electric fields can modulate specific circadian rhythms, natural daily cycles of body function such as the secretion of various hormones, levels of alertness, activity and body temperature which continue even when normal "time signals", such as light and dark periods, are removed. In animals, such effects have been found after exposure to power frequency electric fields, but at levels well above threshold for the perception of the surface electric charge. In humans, one study has suggested that very low level (2.5 V m^{-1}) 10 Hz, square wave electric fields could alter the sleep and activity patterns of volunteers living in environments artifically isolated from normal temporal cues. However, the study was carried out in the presence of unquantified power frequency electric and magnetic fields and it is difficult to draw any firm conclusions from the results.

Exposure to electromagnetic fields has been reported to inhibit the night-time peak in the synthesis of melatonin, believed to be a natural inhibitor of certain tumours. Hence it has been suggested that this may be a route by which ELF fields could influence tumour progression. However, although several groups have reported the field-dependent reduction in melatonin, this effect has not always been successfully replicated, and the link between exposure to electromagnetic and melatonin inhibition remains tentative.

Reproduction and development

A large number of animal studies have been carried out which have investigated the potential for ELF and very low frequency (VLF) electric and magnetic fields to affect embryo and fetal development. Most well-conducted studies of the effects of exposure to power frequency electric fields on mammalian development have reported the absence of consistent and reproducible teratogenic responses. A number of studies have reported abnormal development of chick embryos exposed to pulsed or sinusodial magnetic fields greater than about 1 μT at frequencies between 10 and 1,000 Hz. In contrast, other studies, including one which examined the effect of exposure to VLF sawtooth magnetic fields characteristic of visual display unit emissions, failed to find such effects. A large scale study in which replicate experiments were carried out in six different laboratories recently failed to establish that such effects occur reproducibly. Studies of possible magnetic field exposure on mammalian development are more relevant to humans. In general, most studies report a lack of effect on any developmental end-point; the few positive effects reported are not consistently demonstrated in different studies and may perhaps reflect the spurious significance seen when large numbers of parameters are analysed separately. Most studies of mice and rats exposed throughout gestation to power frequency fields up to 20 mT or VLF sawtooth magnetic fields of up to 200 μT have not found decreased levels of post-implantation survival. Similarly, most studies of rodents exposed during gestation to power frequency magnetic fields of up to 20 mT, or VLF fields of up to 200 μT have found no significant effects on the incidence of gross external abnormalities, nor on the incidence of visceral or skeletal abnormalities, although several studies have observed an increased number of skeletal variants which also occur spontaneously. In addition, studies report a lack of consistent effect on postnatal developmental and juvenile and adult behaviours.

Carcinogenesis

There is much experimental evidence that electromagnetic fields cannot cause genetic damage and it is therefore extremely unlikely that they could have any effect on the initiation of cancer. It is generally accepted that if ELF fields do affect carcinogenesis it is likely to be at the level of promotion, possibly stimulating the proliferation of potentially malignant cells. Studies at the cellular and subcellular levels have investigated the possibility that exposure to ELF fields may result in interactions at the cell membrane which trigger cell signalling pathways leading to increased cell division. Other studies have looked for the effects of ELF fields on the expression of proto-oncogenes known to be involved in regulating cell growth. Positive effects have been reported in some laboratories, although some of these results have been small and variable. In general, however, the more carefully conducted studies have failed to find any clear effect of exposure to ELF magnetic fields. In the RF region, there are some data from cellular studies using an atypical mouse fibroblast cell line that exposure may induce dose-dependent DNA changes leading to uncontrolled cell proliferation which can only be revealed by the concurrent action of a chemical promoter. The relevance of these results to normal human cells is, however, questionable.

A number of large scale animal carcinogenesis studies have been completed in which animals have been exposed to power frequency magnetic fields, sometimes in conjunction with chemical carcinogens and promoters in order to test for any promoting or co-promoting activity. Studies of tumour promotion have generally yielded equivocal results, although an increased incidence of mammary tumours has been reported in two studies of rats treated with a chemical carcinogen and exposed to magnetic fields. A co-promoting activity, in which exposure to magnetic fields enhanced the effect of a carcinogen in the presence of sub-optimal levels of a chemical promoter, has been reported but the authors have experienced difficulty in repeating their own studies. Overall, the available experimental evidence remains contradictory and does not provide a clear indication that ELF electromagnetic fields affect tumour promotion.

Few large scale animal carcinogenesis studies have been carried out with RF and microwave radiation. One study, in which rats are exposed for most of their lifetime to low level pulsed microwave radiation, reported that the exposed group had a significantly higher incidence of primary malignant tumours compared to the control group. However, the tumour incidence in the exposed group did not appear enhanced compared to values reported elsewhere in stock rats of the same strain; rather, values were low in the control group. Thus, these data do not provide clear evidence of an increase in tumour incidence as a result of exposure to microwaves. Other studies have reported that the chronic microwave exposure of mice at high SARs (2 to 8 W kg ^{1}) resulted in an increase in the progression or development of spontaneous [mammary] or chemically-induced [skin] tumours; heating effects, however, could not be ruled out.

Frequency/amplitude specific effects

The possibility that only certain combinations (windows) of EMF frequency and amplitude could elicit biological effects has been reported in studies in which exposure to very low levels of amplitude-modulated RF radiation, too low to involve heating, altered the brain activity in cats and rabbits, the activity of an enzyme involved in tumour promotion, and was shown to affect calcium ion mobility in brain tissue *in vivo* and *in vitro*. Effective SARs *in vitro* were less than 0.01 W kg^{-1} occurring within modulation frequency windows usually between 1-100 Hz and sometimes within power flux density windows. The changes in calcium ion-mobility have not been easy to corroborate, two groups have failed to observe these effects in similar studies. It has been suggested that the observed responses may result from the amplitude modulation signal, rather than the RF carrier; similar effects have been reported at ELF frequencies. The biological responses to low level ELF electric fields (less than .100 V m^{-1}) include the altered mobility of calcium ions in chick and cat brain tissue, changes in neuronal firing patterns in rodents and in electricity activity of the brain, and changes in the operant behaviour of non-human primates. Extension of the work which identified changes in the exchange of $^{45}Ca^{2+}$ in isolated chick brain in response to very weak electromagnetic fields led to the proposal of resonant interactions in which it has been suggested that the local geomagnetic field plays a role in transduction. It has been reported that combined static and time varying magnifying fields can affect calcium-dependent movement of marine micro-organisms or the uptake of radio-labelled calcium ions when the ELF frequence is at an appropriate resonance frequency for calcium ions. In addition, other recent experiments report that the performance of an operant task and a spatial memory task are impaired in rats only during exposure to combined static and resonant ELF magnetic field.

Low level pulsed RF effects

Recent well-conducted studies by one group of research workers suggest that the retina, iris and corneal endothelium of primate eyes are susceptible to low-level microwave irradiation, particularly to pulsed radiation. Various degenerative changes, particularly of the light-sensitive cells in the retina, have been reported; specific energies per pulse [10 μs pulses at 100 pulses per second] were 26 mJ kg^{-1} and even as low as 2.6 mJ kg^{-1} after the application of a drug used in the treatment of glaucoma. Exposure to low levels of pulsed or continuous wave RF or microwave radiation have been reported to affect neurotransmitter metabolism and the concentration of receptors involved in stress and anxiety responses in different parts of the rat brain. For pulsed radiation, the threshold specific energy per pulse was approximately equal to the microwave auditory threshold.

SUMMARY AND CONCLUSIONS

Many acute effects of exposure to electromagnetic radiation are relatively well established and are used as a basis in setting guidance and restrictions on human exposure (see table 1). The potentially adverse effects on vision and cognitive function during exposure to electric and magnetic fields at frequencies below about 100 kHz can be avoided by restricting the current density induced in the head and trunk. Above about 100 kHz many of the effects of acute exposure to sufficiently intense radiofrequency and microwave radiation result from induced heating. Adverse effects such as heat exhaustion and reduced mental performance resulting from whole body RF heating can be avoided by restricting the whole body SAR; in addition, adverse effects on heat sensitive tissues such as the brain, the lens of the eye and the developing embryo or fetus, and on less sensitive tissues of the trunk and limbs can be avoided by restrictions on the localised SAR in the tissue. Above about 10 GHz, recommendations pertaining to long wavelength infrared radiation are applicable since absorption is largely confined to the skin and cornea. In addition, it is recommended that conditions under which the auditory effect can be invoked by exposure to pulsed RF and microwave fields should be avoided, as should the annoying effects of power frequency electric fields caused by the direct perception of surface charge. In some cases, these effects may be avoided by engineering or administrative controls.

Most people are exposed at levels much too low for the effects described above to be significant. There is little biological evidence to suggest that exposure to low-level fields causes adverse health effects. In particular, pregnancy outcome in mammals does not appear to be affected by exposure to levels of low frequency electric or magnetic fields encountered in domestic and office environments. Recent evidence suggests that high peak power pulsed RF and microwave radiation may engender specific behavioural effects, possibly as a consequence of audition of the field; other effects of pulsed radiation at very low levels of exposure, such as degenerative changes in the tissues of the eye and changes in neurotransmitter metabolism, have yet to be confirmed. Much recent biological research has focused on carcinogenic processes, following a number of studies linking the incidence of some adult and childhood tumours to mostly surrogate estimates of electromagnetic field exposure such as job description. Electromagnetic fields are not mutagenic and so are unlikely to initiate tumours. Recent studies have mostly concentrated on aspects of cellular metabolism relevant to tumour promotion or on an enhancement of the incidence of spontaneous or chemically-induced tumours in animals. However, there is little persuasive evidence to suggest that electromagnetic fields are able to influence any of the accepted stages in carcinogenesis; few clearly reproducible effects are apparent. The results of the large scale animal studies are mostly equivocal, although tumour progression may be enhanced at thermally significant levels. Some data challenge the conventional assumption that the magnitude of an effect increases with increasing exposure. In general, however, the effects following exposure to low level fields have not been well established and they do not provide a basis for restrictions on human exposure.

Table 1

BIOLOGICAL BASIS FOR RESTRICTIONS ON HUMAN EXPOSURE—NRPB 1993[1]

Dosimetric quantity	*Adverse effect*	*Restriction*
Frequencies of less than 100 kHz		
Surface electric charge (50/60 Hz)	Stress of direct perception	Avoid[2]
Induced current density (10 Hz–1 kHz)	Visual and mental disturbance	10 mAm^{-2} (head and trunk)
Frequencies between 100 kHz and 10 GHz		
Specific Absorption Rate (SAR)	Body temperature > 38°C	0.4 W kg^{-1} (average over body)
	Head and fetus > 38°C	10 W kg^{-1} (average over 10 g)
	Trunk > 39°C	10 W kg^{-1} (average over 100 g)
	Limbs > 40°C	20 W kg^{-1} (average over 100 g)
Frequencies between 10 GHz and 300 GHz		
Power density incident on body	Excess surface heating of the skin and cornea	100 W m^{-2}
Pulsed radiation of frequencies between 100 MHZ and 10 GHz		
Specific energy per pulse (SA)	Stress of perception	Avoid[2]

Notes:

(1) The full basic restrictions currently advised by NRPB are given in the accompanying notes[7].

(2) These effects can also be avoided by administration or engineering controls.

FURTHER READING

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UNEP/WHO. Extremely Low Frequency (ELF) Fields. Geneva, World Health Organization Environmental Health Criteria 35 (1984).

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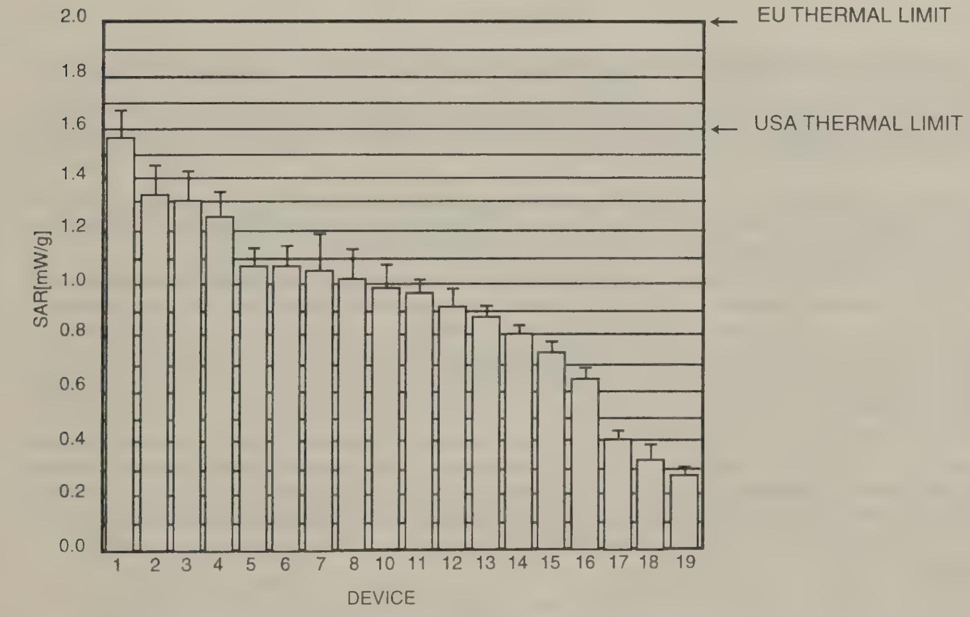
UNEP/WHO. Electromagnetic Fields (300 Hz–300 GHz). Geneva, World Health Organization Environmental Health Criteria 137 (1993).

Annex 2

Extract from: *"Current state of dosimetry techniques & results"* Neils Kuster; Swiss Federal Inst—Technology, Zurich talk at *"Mobile Phones"—is there a health risk?* IBC Conference, London, 14 October 1998.

Reference [5]

Specific Absorbtion Rates of GSM Mobile Phones



Nineteen different GSM devices were tested according to the CENELEC prES59005 document (Chanel 62 = 902.4 MHz; Nominal time-averaged antenna input power (Class 4) = 0.25 W). Three samples of each phone were tested in the position which resulted in the greatest spatial peak SAR out of the four positions defined in the standard. The SAR values shown are the assessed spatial peak SAR values averaged over 10g and the standard deviation of these three different phones.

5.6 *Handset Modeling*

Since the phone's RF design determines its current strength and distribution and the phone's geometrical design determines the distance from the user's skin, the spatial peak SAR value greatly varies with the design of the phone (see Figure 11). In order to obtain an idea of the variations within the same type of phone, three samples of each of the 16 phones were evaluated. Large variations of up to 30 per cent were found even though the output power at the adapter terminal was within ±0.1 dB.

Furthermore, a study comparing numerical and experimental procedures [53] showed that the spatial peak SAR differed by more than 50 per cent for some phone positions, even though the field magnitude and current distribution differed only slightly.

This illustrates the great dependence of the absorption on the exact magnitude and distribution of the RF currents on the phone. Since the current distribution can be altered by minor design details in the phone (eg, matching network, capacitive coupling between various parts of the device, etc), compliance testing requiring modeling of the phone is a highly questionable approach due to the difficulties in assessing the uncertainties across all differences arising from mass production. Experimentally, this problem can be effectively handled by evaluating the spatial peak SAR of various samples of the mass production and using appropriate statistical methods to assess the uncertainty source.

Studies in which the position and phone can be precisely described show good agreement between measurements and computations [93, 94, 95].

APPENDIX 7

Letter to the Clerk of the Committee from Mr E G Brennan, Manager, Risk Management Business Centre, Lloyd's Register

I write in response to a query raised with my colleague Dr Gill Reynolds as to whether Lloyd's Register can provide information on the comparison between the possible risks to health due to mobile telephones, and other sources. Unfortunately Lloyd's Register has no significant information on this subject so we are unable to help in this matter.

11 June 1999

APPENDIX 8

Letter to the Committee Specialist from Professor Peter Ramsdale, Chief Engineer, One 2 One

Thank you for your letter of 21 May, to which our Managing Director has asked me to respond. I enclose One 2 One's memorandum. The business is a member of the Federation of the Electronics Industry and endorses the comments in its submission of 9 June.

I have been working on radiocommunications issues continuously since 1967 and joined one of the companies which later merged to form One 2 One in 1989. I am also a visiting Professor to the Centre for Communications Systems Engineering Research at the University of Surrey.

One 2 One takes concern about the possible health effects of mobiles phones and base stations extremely seriously. Having taken account of the advice of national and international scientific bodies and reviewed the science in this area, we do not believe that mobile phones and base stations pose a health hazard to the general public. However, if the public are to have confidence in government policy on this issue, then they need to be convinced that standards are based on up-to-date expert advice. The business therefore supports further research in this area.

In our view, the NRPB is well placed to provide high quality and objective advice to ministers. It is an independent scientific body established by Act of Parliament and its members include some of the most experienced scientists in the field of radiological protection anywhere in the world. We think that NRPB is best placed to co-ordinate research on behalf of the UK but for this to be most effective and relevant the involvement of operators is essential.

14 June 1999

Memorandum submitted by One 2 One

1. INTRODUCTION

One 2 One welcomes the Select Committee's Inquiry. It recognises public concern about the possible health effects of using mobile phones and supports initiatives that add to people's understanding of the issues involved.

Mobile phone networks operate using radio signals to link handsets to base stations (cell site). Base stations are in turn linked to central switching centres, which track calls and transfer them from one base station to another as the caller moves through the radio coverage area. Base stations only cover relatively small areas because they operate at low power levels. The exact radius depends on the terrain (the signals can be blocked by obstructions like trees) and the number of calls that the network needs to carry in any given area. But they will typically be about 0.5 kilometres in towns and 2 kilometres in open countryside.

2. Summary

- One 2 One believes that the industry has an important role to play in working with government and others to develop research and communications programmes on RF radiation issues. It has a wealth of experience in this field and an interest in protecting its customers. Research conducted by scientists associated with the industry should not be sidelined.
- One 2 One believes that research in this area needs to be co-ordinated globally, or at least on a European scale—rather than piecemeal by individual countries.
- All four mobile operators pay substantial licence fees to the Radiocommunications Agency for the use of their radio spectrum. The Government will also raise considerable sums (possibly £1 billion) from the auction of so-called UMTS spectrum. We suggest that a portion of these monies be earmarked for further research.
- One 2 One believes that there is an urgent need to provide local authorities with clear advice on the Government's position on mobile base stations and health. Current guidance (PPG8) simply states that it is a matter for the Health and Safety Executive (HSE). Although the HSE takes exactly the same line as the NRPB in relation to exposure guidelines and possible health effects, local authorities need this advice to be enshrined in clear government guidance. Any guidance should be based on sound scientific evidence and should set down procedures that can be adopted uniformly throughout the UK.
- One 2 One believes that public policy should be based on sound scientific evidence. If the Government is considering policies designed to address public concern about the possible health effects of exposure to RF radiation (over and above the standards already set), then these should be applied uniformly to all operators whose activities expose members of the public to electromagnetic radiation.

3. Possible Health Effects of Using Mobile Phones

Both handsets and base stations emit radio frequency (RF) radiation—as do TVs, computers and other domestic electronic equipment. As a result, people are exposed to low level RF radiation and other electromagnetic waves every day of their lives. Mobile handsets and base stations operate at low power levels. The power output of the Crystal Palace television station, for example, is over a thousand times greater than the average base station.

The National Radiological Protection Board (NRPB) recommends limits within which all radio systems must operate. These recommendations have been adopted by the Government and are specifically designed to protect the public from the effects of the RF radiation. Both handsets and the equipment used in base stations comply with these standards. Mobile operators also use them to calculate exclusion zones around the antennas on their base stations. Safety signs make clear that people should not enter when the antennas are operating.

Radio transmissions have been used for telecommunications purposes for over a century and there is already a wealth of research and experience on their effect on human health. Both the NRPB and international bodies such as ICNIRP (the International Commission on Non-Ionising Radiation Protection) have analysed that research. The following are extracts from the NRPB's latest Information Sheet, published this month:

- "Radio wave strengths at ground level and in regions normally accessible to the public are many times below hazard levels and no heating effect could possibly be detected. NRPB staff have made many measurements to support this view" (NRPB Information Sheet, June 1999);
- "The limit for exposure to the head . . . is 0.1 watt of power absorbed in any 10g of tissue . . . In practice, the output from mobile telephones used in the UK results in only a fraction of this amount of energy being deposited in the tissues of the head, and therefore the rise in temperature would only be a fraction of a degree. This is similar to the normal daily fluctuations in body temperature and such small changes in heat load are considered to be too low to cause adverse effects" (ibid);
- "Radio waves do not have sufficient energy to damage genetic material in cells directly and cannot therefore cause cancer . . . the evidence from biological studies on possible effects on tumour promotion or progression, including work with experimental animals, is not convincing" (ibid); and
- "Despite the rather limited epidemiological and experimental data available, NRPB concludes that the totality of the evidence available does not suggest that the use of mobile phones have any detrimental effect on human health. Nevertheless there does remain a need for further research" (*ibid*).

One 2 One endorses the NRPB's position based on the available research. We would also stress that although people have been exposed to comparable or greater levels of RF radiation than those emitted by today's mobile phones for decades, no substantive evidence of health damage has been demonstrated.

4. The Quality and Objectivity of Advice

The NRPB, which was established by the 1970 Radiological Protection Act, has a duty:

- "by means of research and otherwise, to advance the acquisition of knowledge about the protection of mankind from radiation hazards"; and
- "to provide information and advice to persons (including Government departments) with responsibilities in the United Kingdom in relation to the protection from radiation hazards either of the community as a whole or of particular sections of the community".

The NRPB is independent of both government and industry. Its staff includes internationally renowned experts in the field of radiological protection. One 2 One believes this structure ensures that the NRPB is in a position to give the Government high quality and independent advice on these issues.

One 2 One itself employs a number of staff specifically to keep abreast of developments in this field—as do other operators in the industry. Given the breadth of experience the industry has, we believe it is essential that there is proper consultation with operators and manufacturers on this issue.

One 2 One believes that operators can play a greater part in epidemiological and other studies. It is important that a mechanism is found to involve operators more fully, otherwise research may be of only marginal significance to emerging systems. This is because epidemiological research takes many years to conduct while telecommunications technology changes very rapidly.

One 2 One believes that the industry has an important role to play in working with government and others in developing research and communications programmes on RF radiation issues. It has a wealth of experience in this field and an interest in protecting its customers. Research conducted by scientists associated with the industry should not be sidelined.

5. The Need for Further Research

Although a great deal of research has already been undertaken, One 2 One supports further work in this area. In particular we support co-ordinated initiatives through our partner companies, the FEI, GSM Association and the EC. To date, the industry has invested about $US 50–60 million worldwide in research into the health effects of using mobile phones. It will continue to support further research—including the European Commission's Fifth Framework programme. It is essential that any research—irrespective of its findings—is published and independently assessed.

One 2 One believes that research in this area needs to be co-ordinated globally, or at least on a European scale—rather than piecemeal by individual countries.

All four mobile operators pay substantial licence fees to the Radiocommunications Agency for the use of their radio spectrum. The Government will also raise considerable sums (possibly £1 billion) from the auction of so-called UMTS spectrum. We suggest that a portion of these monies be earmarked for further research.

6. The Development of Policy

Radiological protection experts, at both a national and international level, are agreed that any standards designed to protect the public "should be based on sound scientific evidence relating to established effects on human health" (NRPB information Sheet, No 3/98). One 2 One supports this approach. Public policy should also be based on sound scientific evidence—not driven by press speculation or by unpublished research that has not been peer reviewed.

The One 2 One believes that there is an urgent need to provide local authorities with clear advice on the possible health effects of mobile base stations. Current guidance (PPG8) simply states that it is a matter for the Health and Safety Executive (HSE). Although the HSE takes exactly the same line as the NRPB in relation to exposure guidelines and possible health effects, local authorities need this advice to be enshrined in clear government guidance. Any guidance should be based on sound scientific evidence and should set down procedures that can be adopted uniformly throughout the UK.

7. A Uniform Approach

Press attention has tended to focus on the possible health effects of mobile phones and base stations. Yet mobile apparatus is not unique in generating RF radiation—broadcasters, the electricity industry, the Ministry of Defence, emergency services and private mobile radio operators are all involved in activities that expose members of the public to electromagnetic radiation.

One 2 One believes that public policy should be based on sound scientific evidence. If the Government is considering policies designed to address public concern about the possible health effects of exposure to RF radiation (over and above the standards already set), then these should be applied uniformly to all operators whose activities expose members of the public to electromagnetic radiation.

14 June 1999

APPENDIX 9

Letter to the Committee Specialist from Mr Barry Cartman, Managing Director, British Approvals Board for Telecommunications (BABT)

I am responding to your request for a submission on the above topic.

BABT is the main body in the UK dealing with regulatory approval of telecommunications terminal equipment. For the most part, this activity takes place in the context of Directive 98/13/EC as implemented in the UK by the Telecommunications Terminal Equipment Regulations 1992 (as amended).

Approval is granted on the basis of harmonised standards for which the relevant references have been published in the Official Journal of the European Communities. These standards do not, at present, make any direct reference to health issues associated with mobile phones. This does not mean to say, of course, that those responsible for preparing the standards did not take such factors into account when setting the standards. There is simply no explicit requirement in relation to the health impacts.

Accordingly, there is no explicit assessment of health risks in the assessment of mobile phones as part of their approval. For our part, we do point to some of the risks associated with mobile phones in our own Application Note 49.[8] See, in particular, "Note 8—User Instructions" in the copy enclosed.[9] These requirements used to be mandatory in the UK prior to the current EU approval scheme but we no longer have authority to enforce them as part of the approval.

In general, I am sure that you are aware that consumer safety of electrical products is covered by the Electrical Equipment (Safety) Regulations implementing Directive 73/23/EC. There is no mandatory third-party verification of compliance with these regulations by way of approval. More important, in the current context, mobile phones fall outside the scope of the Regulations because of the imposition of a working voltage range which excludes most battery operated equipment. Save for this, these Regulations would address radiation which could cause danger.

Opportunity to remedy the anomalies mentioned in the preceding paragraphs will arise with implementation of Directive 1999/5/EC which is currently in hand. This removes the restricted voltage range of 73/23/EC when applied to telecommunications equipment. The problem will then move on to the development of a harmonised European standard which addresses the health impact of mobile phones. CENELEC have been looking into this under a mandate from the Commission but I am not aware that the matter has yet been brought to a conclusion.

You will see from these remarks that BABT has little direct involvement in the area of interest to your Committee but I trust that you will, nevertheless, find these remarks helpful.

APPENDIX 10

Memorandum submitted by Friends of the Earth Scotland

Introduction

1. Friends of the Earth Scotland became involved in researching this area, and specifically that of the possible adverse health effects for people exposed to the emissions of microwave radiation from mobile phone base station transmitter masts, as a result of growing scientific, political and public concern. Our main involvement has been that of working constructively with Local Authorities across Scotland, and increasingly throughout the UK, who have been concerned with the lack of clear guidance originating from the Government and the National Radiological Protection Board (NRPB) on this issue.

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[8] Global System for Mobile Communication (GSM)—Pan-European Cellular (GSM900 and GSM 1800/DCS 1800/PCN).

[9] Not printed.

QUALITY AND OBJECTIVITY OF ADVICE PROVIDED

2. From an early stage, in our involvement in this issue, it became apparent that there were a number of inconsistencies within the arguments used by the NRPB in their arriving at the current public exposure guidelines which we have in place today.

3. We were particularly interested in the effect which exposure to microwave radiation may have on children whilst their bodies are still developing. We were aware that the NRPB only recognised the thermal biological effect of microwave, and non-ionising radiation, but were also familiar with the fact that children would appear to be particularly susceptible to absorbing this type of radiation (Gandhi (1990))[10]. This area was, and is, of great interest to us given the large number of mobile phone transmitter masts currently located on top of schools and in school playgrounds throughout the country.

4. Given the NRPB's setting of a level of 0.4W/kg for the restriction of whole body specific absorption rate (SAR) in 1993[11], we were very concerned to discover that biologists within the NRPB had previously published a report in 1991[12], clearly stating:

> "It is clear that some groups of people are less heat tolerant than others. These include people with compromised thermoregulatory ability, such people may well include those with cardiac and circulatory problems, or with a fever or taking certain drugs. In addition, infants, pregnant women and old people may be compromised in this respect. It seems reasonable to suggest that such people should not be subject even to small heat loads from RF sources. A restriction of whole-body SAR to about 0.1W/kg should incorporate a sufficient margin of safety for this latter group . . ."

5. In November 1998[13] we asked the NRPB for an explanation of this discrepancy. The NRPB responded by informing us that this document was one in which "biologist colleagues have at NRPB outlined their views on the biological effects of exposure to RF (including microwave) radiation . . . the NRPB's view is that there was no scientific justification for the use of an extra reduction factor"[14]. As this report was on biological effects of exposure to RF/MW radiation and was written by biologists within the NRPB, we found it quite alarming that this advice had been rejected.

6. We have still not received a satisfactory explanation from the NRPB as to why the upper figure was chosen for public exposure levels in the UK when it was clearly stated that this did not allow a sufficient margin of safety. This is a matter which we have also taken up with Mr A Langlands, Chief Executive, Department of Health, whilst writing to enquire if the Department of Health have a policy regarding the siting of mobile phone transmitter masts and are yet to receive a response[15].

7. We were further interested to learn of an NRPB study, launched in November 1998[16], into the occupational effects of exposure to radiofrequency and microwave radiation, for those working in the telecommunications industry when the NRPB had stated only six years before that there was no such risk[17]. Whilst welcoming the announcement of further research we were concerned to learn of the apparent need to launch a study into this area quite so soon, given the nature of the earlier statement.

8. Moving away from the thermal effects of exposure to microwave radiation, we are extremely concerned about the reluctance of the NRPB to acknowledge the possibility of the existence of non-thermal effects. The equivocal nature of the language used by the NRPB—"firm", "convincing" and "substantiated" etc does not inspire confidence in other scientists, politicians, other governmental organisations or, indeed, the public. We recognise that this is still a controversial area of science, but would point out that we do not need to wait for categorical evidence of a possible link between exposure to emissions from transmitter masks and ill-health before acting. In the UK we have a legal obligation under the Treaty of Maastricht 1993 (Article 130r) to take a precautionary approach in matters such as this and this was recently reinforced by a European Parliament recommendation[18] that "it is imperative to protect people living in Member states from the actual or potentially harmful long-term effects of exposure to electromagnetic fields", as generated by these transmitter masts.

9. Earlier this year the Local Government Association (LGA), representing every Council in England and Wales, responded to a Consultation Paper issued jointly by the Department of Health (DoH) and the Department of the Environment, Transport and the Regions (DETR), and by the Scottish Office Health

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[10] Gandhi, O P, 1980: "State of knowledge for electromagnetic absorbed dose in man and animals". Proc IEEE, 68 (1), 24–32.

[11] Restrictions on Human Exposure to Static and Time-Varying Electromagnetic Fields and Radiation—NRPB, Vol 4, No 5, 1993.

[12] Biological Effects of Exposure to Non-Ionising Electromagnetic Fields and Radiation: III, Radiofrequency and Microwave Radiation (NRPB-R240; May 1991).

[13] Letter to Dr A McKinlay, Director for Non-Ionising Radiation, NRPB—9 November 1998.

[14] Letter from Dr A McKinlay, Director for Non-Ionising Radiation, NRPB—2 December 1998.

[15] Letter to Mr A Langlands, Chief Executive, Department of Health.

[16] UK National Research Study Into Occupational Exposure to Radiofrequency Fields, NRPB, November 1998.

[17] "The Doll Report": Electromagnetic Fields and the Risk of Cancer—NRPB, Vol 3, No 1, 1992.

[18] The Parliament were considering "proposal for a Council Recommendation on the Limitation of Exposure of the General Public to Electromagnetic Fields 0Hz–300GHz (COM(98)0268-C4-0427/98-98/0166(CNS)).

Department (SOHD)/Scottish Office Development Department (SODD) in Scotland[19]. In their response[20] the LGA found the whole Government and NRPB decision-making-process of waiting for categorical/clear evidence to be fundamentally flawed and advised that all Councils in England and Wales should adopt precautionary policies. Additionally, the LGA found the Government's advice to be "questionable . . . misleading . . . and unacceptable that the public's health should be subject to the possibility of compromise."

10. At the same time as the LGA were responding to the consultation paper in England and Wales we submitted our response to the Scottish Office[21] and found the whole tone of the draft circular and the accompanying draft World Health Organisation (WHO) report[22] circulated with it to be extremely cynical. It is appreciated that the WHO are an entirely separate body from the UK Government, but as this report was written by two members of NRPB staff it is particularly relevant and demonstrates the lack of objectivity which the scientific community might come to expect. This report had a number of inaccuracies and misleading statements and went as far as to advocate the cynical exploitation of public trust in an attempt to reassure them, and manage public concern, by suggesting that Local Authorities should hire or purchase hazard assessment meters which the report recognised would not be sufficiently sensitive to monitor the low-level emissions with which we are concerned[23]. This practice could not and should not be condoned under any circumstances.

11. As a direct result of the conflicting and contradictory nature of Government, and NRPB, advice on this issue Local Authorities are increasingly deciding to introduce precautionary policies, independently, until such time as clear guidance is given to them. Nowhere has this action been more prominent than in Scotland where over one third of Scottish Local Authorities[24] have now adopted, or are publicly committed to adopting, precautionary policies in the absence of clear Government guidance. We have been asked for considered independent advice by these Local Authorities and are now being approached by, and working constructively with, an ever-increasing number of Authorities not only across Scotland but also from throughout the UK. Officials and Councillors are realising that the current planning system, through the use of Permitted Development Rights, is not working and is failing to protect the interests of the public—particularly on health grounds, as health is still not deemed to be a planning consideration, when considering appropriate sites for these masts, despite there having been three separate Government consultation exercises on this issue last year.

12. A further problem for Local Authorities, and other concerned parties, is the number of Government Departments and Agencies involved and their apparent reluctance to question any of the advice emanating from the NRPB. It is appreciated that Government Departments fulfill complementary roles, but in this area the number of parties involved only serves to confuse this issue. The Department of Trade and Industry (DTI) are involved in licensing the Network Operators, the DETR in the planning process, the DoH and the Health & Safety Executive (HSE) on the health side and finally the NRPB to which they all defer. If the situation was not complicated enough by this, there is a further conflict of interest for the Government and that is with the entering into commercial lease agreements with Network Operators to site transmitter masts on top of Government buildings—this added dimension further blurs the objectivity with which Government Departments can be seen to be carrying out their duties.

Conclusion

13. There is an urgent need for the NRPB to revise their public exposure guidelines in order to minimise the potential risk to public health; to include potential non-thermal effects in their setting of public exposure guidelines; and to include scientific studies on non-thermal effects in their review of scientific studies when setting guidelines in order to reflect scientific concern from around the world.

14. A precautionary approach should be adopted by the UK Government as a matter of urgency in order to allow further research to be carried out.

15. The planning system has to be changed in order to protect the interests of the public, as the system of Permitted Development Rights has clearly failed to do this.

9 June 1999

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[19] Draft Scottish Office Development Department (SODD)/Scottish Office Health Department (SOHD) Circular: Land-Use Planning and Electromagnetic Fields (EMFs), 29 December 1998.

[20] LGA response to draft advice to local planning authorities on land-use planning and development giving rise to electromagnetic fields, LGA, 1999.

[21] Draft Scottish Office Development Department (SODD)/Scottish Office Health Department (SOHD) Circular: Land-Use Planning and Electromagnetic Fields (EMFs)—Response by Friends of the Earth Scotland, 23 February 1999.

[22] Electromagnetic Fields: Draft Report, WHO (Philip Chadwick and Zenon Sienkiewicz), 1998.

[23] As above, p 22.

[24] Aberdeen City, Aberdeenshire, Angus, Clackmannanshire, East Dunbartonshire, Highland, Perth & Kinross, Scottish Borders and West Dunbartonshire Councils.

APPENDIX 11

Memorandum submitted by the Health and Safety Executive

INTRODUCTION

1. This memorandum responds to the invitation from the Science and Technology Committee to submit evidence on the case study examining the processes and structures the Government uses to obtain and consider scientific advice on the health impacts of mobile phones.

2. We refer the Committee to our earlier memorandum of a year ago to the main inquiry which sets out the aims of the Health and Safety Commission (HSC) and Executive (HSE) and discusses how we obtain scientific advice and what we do with it. It also includes a number of relevant case studies. We will not repeat the information here but our evidence needs to be read against the background of that memorandum.

3. Much of the evidence below will be explained in greater detail in the memoranda from the National Radiological Protection Board (NRPB) and other Government departments.

HSC/E'S INTEREST IN MOBILE PHONES

4. The overall aim of HSC/E is to ensure that risks to the health and safety of people at work and members of the public from work activity are properly controlled. Mobile phones are used at work. Transmitter base stations are erected and accessed by people at work and are located in the community. HSE needs to identify whether there are any health and safety hazards generated by mobile phones used at work and by the operation of base stations in order to ensure that employers and installers are carrying out their statutory responsibilities to protect the health and safety of employees and others.

5. HSE does not have responsibility for, *inter alia*:

— mobile phones are a consumer product (Department of Trade and Industry (DTI));

— the use of mobile phones while driving (Department of the Environment, Transport and the Regions (DETR));

— the public health dimension (DoH).

6. Because health and safety aspects of all sources of non-ionising radiation, including that from mobile phones and base stations, are of interest to a range of public bodies it is important that those bodies liaise on policy and share information. Policy making is co-ordinated across Government both through membership of a Liaison Group on Non-Ionising Radiation, which is chaired jointly by HSE and DoH and incorporates all interested Government departments and the NRPB, and by a continuous process of contacts.

THE SOURCES OF HSE'S SCIENTIFIC ADVICE ON MOBILE PHONES

7. In line with the Chief Scientific Adviser's Guidelines on the Use of Scientific Advice in Policy Making, HSE draws on the best expert sources of advice both within and outside Government. In common with Government departments HSE's primary source of *independent* advice on radiation matters is NRPB. This is done under the terms of a memorandum of agreement between HSE and NRPB of 5 July 1994 and in furtherence of NRPB's statutory function to provide information and advice to persons with responsibilities in the UK in relation to the protection of particular sections of the community from radiation hazards.

8. However, NRPB is not the only source of advice on electromagnetic fields. Through its small cadre of specialist inspectors, HSE develops technical (health and safety) policy in conjunction with other Government departments and in consultation with the telecommunications industry, taking due account of the views of the scientific community both at home and abroad. This enables HSE to act in an intelligent customer role when critically reviewing the quality and objectivity of NRPB advice and the soundness of those procedures and structures used to obtain that advice. NRPB (and other) advice can be compared with statements by other international bodies and NRPB would be invited to justify any discrepancies.

9. HSE is able to fund or contribute to relevant research and, through its Mainstream Market Research document, has invited proposals for appropriate research. Because HSE does not believe that the consequences of occupational use of mobile phones is any different from social use, it supports broader national and international research rather than commissioning research related specifically to occupational use. HSE liaises with DoH who take the lead on Government research into health effects.

10. Mobile phones may pose a risk to health and safety in ways unrelated to the emission of radiation. For example, it would be unwise to use a mobile phone when undertaking safety-critical work or work which requires dexterity or concentration. We would expect these hazards to be well understood and would require no scientific input to appreciate; any research is likely to be concentrated on the hazards of using mobile phones while driving (DETR lead).

11. In response to public concern about the possible health effects of mobile phones, the Minister for Public Health has instructed NRPB to set up an expert working group to assess the current state of research into

mobile phones. The DoH memorandum will give further information. The DTI memorandum will discuss opportunities for new technologies relating to mobile phones and HSE as appropriate in discussing the challenges and opportunities presented by these developments with duty holders.

ADVICE RECEIVED BY HSE ON MOBILE PHONES

12. The memorandum from the NRPB will explain in greater detail the mechanisms by which it generates advice and the contents of that advice. Formal advice on standards of protection and guidance on their application in practice is published in a series "Documents of the NRPB". In 1993 the NRPB published "Board Statement on Restrictions on Human Exposure to Static and Time Varying Electromagnetic Fields and Radiation" which made recommendations for exposure restrictions across the entire frequency range (0 Hz—300 GHz) of electromagnetic fields based on known acute effects. HSE expects employers to comply with the recommendations in carrying out their statutory health and safety responsibilities.

13. The NRPB's Advisory Group on Non-Ionising Radiation (AGNIR) consists of independent scientists and is chaired by the eminent epidemiologist Sir Richard Doll. It continues to review the scientific evidence in the published literature on exposure to electromagnetic fields and the risk of cancer and published its first report in "Documents of the NRPB" in 1992 with supplementaries in 1993 and 1994. A further report is due which will review the most recent research including the results of the UK Childhood Cancer Study in relation to EMFs. In summary, the current AGNIR advice is that there is no convincing evidence that electromagnetic fields cause cancer but there is a need for further good quality research to be carried out.

14. AGNIR's report and supplementaries encompass the radio waves emitted by mobile phones and base stations. NRPB has issued a sequence of information sheets and press releases applying this general advice specifically to mobile phones and base stations. Its advice on effects other than cancer is that mobile phones currently in use in the UK comply with the NRPB's recommended exposure restrictions and that scientific data suggesting other possible effects are few and inconsistent. At base stations, radio wave levels can exceed NRPB's recommended exposure restrictions within a few metres directly in front of the antennae, but levels in regions accessible to the public are usually well below the recommendations.

15. NRPB's advice is broadly consistent with statements issued by several international bodies, including the International Commission on Non-Ionising Radiation Protection (ICNIRP), a European Commission Expert Group and the World Health Organisation (WHO). All these bodies state the need for further reasearch, and much is currently being co-ordinated internationally. HSE represents UK Government on the Advisory Committee to the WHO International Electromagnetic Fields Project. This project comprises a long-term programme for a comprehensive review of EMF effects, including radio waves. Active participation by HSE in the associated international workshops and technical seminars is helping to shape this programme. As a part of the project, the International Agency for Research on Cancer (IARC) is co-ordinating a large international study on the health effects of mobile phones.

SUMMARY

16. The Government's consensus view is derived from the advice received from NRPB and other sources listed above and is continually reviewed in the light of any changes in the advice as new evidence becomes available. In line with other Government departments, HSE's response to enquiries on mobile phones and base stations is that there is currently no cause for concern about radio wave emissions, but that there is continuing need for quality research.

APPENDIX 12

Letter to the Clerk of the Committee from Mr John Royds, Non-Ionising Radiation Consultant

REDUCING MICROWAVE EXPOSURE

I shall be grateful if you will allow this short submission to be included in material considered by the Science and Technology Committee. Personally, I do not use a mobile phone. However, I believe that information about steps that can be taken to reduce exposure should be made available to the general public through this committee.

1. EXCLUSION OF MOBILE PHONES FROM PRESCRIBED LIMITS

In 1988, the International Non-Ionizing Radiation Committee of the International Radiation Protection Association [IRPA, 1988] excluded low power transmitting devices from "consideration in assessing compliance with the prescribed limits provided the radiofrequency output power of the device is seven watts or less".

Mobile phones usually operate at least 10 times below this exclusion limit of seven watts.

Many in the bioelectromagnetic community consider this exclusion was inappropriate and it was not until 1996 that the International Commission on Non-Ionizing Radiation Protection (essentially the same group as the 1988 IRPA committee) imposed a two watts per kilogram heating standard for microwave exposure in the head averaged over 10 grams of tissue for the general public using mobile phones [ICNIRP, 1996].

2. RESEARCH

The result of this exclusion was that little research was done by the mobile phone manufacturers into long-term bio-effects that may be associated with mobile phone use which may include brain tumours, headaches and short-term memory problems.

3. REDUCING EXPOSURE

3.1 *VDUs*

The computer screen (Visual Display Unit or VDU) is a comparison. There were many anecdotal reports of female VDU operators suffering abortions and abnormal pregnancies. The Swedes did two studies exposing mice to the VDU saw-tooth magnetic fields from the fly-back transformer and vertical deflection coil. The results showed abnormal pregnancies and increased abortions. Rather than spending many years replicating these studies, the Swedes redesigned the VDU so the saw-tooth magnetic field emissions were reduced substantially at minimal extra cost. Now virtually all the VDUs sold comply with the Swedish standard. The manufacturers' sales pitch was that their customers "preferred low radiation monitors".

3.2 *Nickel Mesh Case and Aerial Guard*

A similar policy could be used by the mobile phone makers and low-radiation phones would become the norm because of consumer preference. Again, the actual cost to the industry would be minimal. A company based in greater London (Microshield Industries plc, Microshield House, 59 Southbury Road, Enfield, Middlesex EN1 1PJ, website <www.microshield.co.uk>) has patented a nickel mesh shield case and aerial guard. Tests conducted by BT have shown that the *Microshield* reduces the microwave absorption in the brain by over 90 per cent. Installing these patented features into the mobile phone at the manufacturing stage would only increase the cost by a small amount.

3.3 *Use of Mobile Phones in Vehicles*

Cars and other vehicles screen the microwave emissions from the mobile phone when in use and so act as a Faraday cage. GSM phones compensate for this by increasing the power output resulting in greater microwave absorption in the user.

By using an external aerial mounted for example on the roof, this absorption inside the vehicle is reduced substantially. By placing the microphone on the windscreen pillar near the operator and using loudspeakers, a driver can conduct a conversation "hands-free" with minimal microwave exposure.

3.4 *Hands-Free Kits*

Hands-free kits may transfer the microwave absorption away from the head to the part of body where the phone is placed with equally serious consequences. For example, if the phone is clipped onto a person's belt, this will give increased microwave absorption to the kidneys, liver and gut for example, depending on the precise location. There is also concern that the cable and ear-piece may relay microwaves from the phone to the person's ear. Tests are being conducted on this at the moment.

4. BASE STATIONS

No mobile phone would work without the associated base-stations. People forced to live close to these microwave transmitters are complaining of sleep disruption, headaches and short-term memory problems. The actual microwave levels are usually many orders of magnitude below the present standards. But these standards are only based on avoiding bio-effects caused by microwave heating.

Much more research needs to be done on the low-level bio-effects. Whilst this research is being conducted, the precautionary principle and prudent avoidance should be applied so that the total microwave power-density does not exceed 10 $\mathrm{nWcm^{-2}}$ (ten nanowatts per square centimetre) at the nearest dwelling, school, hospital etc. Many base-stations already comply easily with this 10 $\mathrm{nWcm^{-2}}$ level. A voluntary ALARA (as low as reasonably achievable) 10 $\mathrm{nWcm^{-2}}$ maximum exposure level at base station could be recommended. For those base stations exceeding 10 $\mathrm{nWcm^{-2}}$, a number of options are available to the operators which will reduce the public's involuntary exposure to the microwaves.

5. CONCLUSION

Exposure to microwaves from mobile phones and from the associated base stations can be reduced substantially at minimal cost to the industry. The Committee is urged to make recommendations that this is implemented now rather than waiting many years for the research to be completed on the effects that low-level microwave exposure may have on humans.

15 June 1999

REFERENCES

IRPA, 1988: "Guidelines on limits of exposure to radiofrequency electromagnetic fields in the frequency range from 100 kHz to 300 GHz". International Non-Ionizing Radiation Committee of the International Radiation Protection Association. *Health Physics* vol. 54, No. 1 (January) pp 115–123, 1988

ICNIRP, 1996: "Health issues related to the use of hand-held radiotelephones and base transmitters". International Commission on Non-Ionizing Radiation Protection. *Health Physics* vol. 70, No. 4 (April) pp 587–593, 1996

APPENDIX 13

Memorandum submitted by Microshield Industries plc

INTRODUCTION

Since 1995, Microshield Industries PLC (MSI) has been at the forefront of the mobile phone health debate, often called upon by press and TV to represent the contrary viewpoint to the establishment and also often criticised by the cellular industry and the NRPB for "scare mongering" or "providing a solution to a problem that doesn't exist".

We have been marketing our product to mobile phone users since April 1996. Called the Microshield, it comes in the form of a high quality leather carrying case containing shielding materials and an antenna guard which protect against the radiation emissions which would otherwise be absorbed by the user.

MSI's increasing influence in this debate has recently been illustrated by being asked by a leading world wide conference company to put together what will be the world's biggest and most objective conference to date, on the subject of mobile phone health risks (1). Previously MSI has been the sole speaker representing the other side of the debate in cellular industry organised conferences aimed specifically at demonstrating the safety of mobiles. We are due to speak at three more already planned for 1999.

EVIDENCE

Users' Symptoms

Since launching to the public, MSI has recorded details from thousands of users complaining of a range of symptoms which they have blamed on their mobile. The cellular industry themselves deny receiving such complaints, yet many sufferers have contacted their mobile manufacturer before contacting MSI. The NRPB calls this group of users "anecdotal evidence" and will not include them in any risk assessment. Yet without anecdotal evidence how does a public health problem manifest itself in the first place? These are real people with real problems and should not be treated as if they didn't exist.

MSI's database of victims formed the basis of a paper presented to a cellular industry conference in London in October 1998(2). This talk was published within the conference proceedings and now forms part of the epidemiological literature on the subject of user symptoms (3).

May 1998 had already seen results released of a large scale Scandinavian survey sponsored by government and industry, supporting Microshield's own experiences. The study itself involving thousands of "victims", confirmed a significant correlation between the length and number of phone calls made and the incidence of symptoms (4). A paper had already been published on one of the most prevalent symptoms, headaches, by an American scientist whose work on this is well known (5).

The cellular industry call these symptoms psychosomatic, but users are now registering their problems world wide. Many can also reproduce symptoms on the other side of the head, by changing ear etc. What makes the evidence most compelling however is not just the numbers involved, but the similarity in symptoms being experienced from users reporting the same types of problems, some quite obscure by nature (3), time and time again, and in different countries all around the world.

NRPB's Incorrect Statement to the Science and Technology Committee (STC)

Last week's national press reported on remarks attributed to Professor Roger Clarke from the NRPB made to the STC, implying that radiation shields which are meant to eliminate the rays emitted by mobiles, were not effective because a mobile "increases its power level and end up with the same exposure as it was before."

Whilst this may be true for other shielding products, it is not so for the Microshield. MSI has already made the NRPB aware in a letter dated 16 February (6), that tests by the National Physical Laboratory (7) sponsored by the BBC for its Healthcheck programme, had shown quite clearly that the Microshield radiation protection case did not subject the user to the same, or indeed, higher exposure levels than if shielding had not been applied in the first instance and in fact offered demonstrable levels of shielding, particularly in weak signal areas when the mobile is operating at its highest level and thus giving off the most amount of radiation. MSI also pointed out that the test protocol used by the NPL had been "approved" by the NRPB (8). Subsequent tests by the NPL have in fact shown a 90 per cent reduction in absorption by the user (9).

In the UK alone, the Microshield has been tested on a British Approvals Board of Telecommunications digital network simulator (10) and also independently by British Telecommunications PLC (11). Both these tests showed shielding in excess of 90 per cent. Four times already this year the National Physical Laboratory (NPL) have tested it. First for BBC's Healthcheck, next for the New Scientist and then a UK national newspaper and finally the BBC again for its Panorama programme. Virtually every mobile manufacturer has tested it in their own facilities, as have all four UK mobile networks. In fact, one of the few people left not to have tested it and confirm its effectiveness is the NRPB, yet they seem happy to comment as if from a position of authority.

Abroad, testing has been carried out at the Moscow Medical Academy (12) and the Department of Physics at Sydney University (13), which further confirmed the Microshield's effectiveness at reducing radiation exposure levels by over 90 per cent. Abstracts of Microshield test results have also been accepted by a peer review group (14). Key to all of Microshield's shielding claim is that it actually eliminates the radiation through absorption and does little in the way of reflecting the radiation back into the phone or user.

On the suggestion by Prof Clarke to your group last week that shielding products cannot protect users from radiation effects, I can categorically say that this is not the case with Microshield users. Whilst not being effective for all "victims", in our aforementioned letter to the NRPB we informed them of the success using the Microshield was having in reducing or eliminating a large proportion of users' symptoms.

We have asked the NRPB for a retraction of Prof Clarke's statement (15) but they have declined claiming Parliamentary privilege was used (16). A phone call with their press office however revealed that Prof. Clarke's comments were meant as a generalisation and not directed necessarily at MSI. Unfortunately we do not accept this was the case, as we ourselves have been openly critical of the NRPB in the past for what we see as an unhealthy tendency for them to appear to side with the cellular industry, rallying to their defence on every occasion they are under pressure (normally following the publication of positive research results).

What is vitally important therefore is that the STC understand that contrary to what Prof Clarke has said, there is a product available to the public which will, in the absence of such advice from the NRPB, help them implement their own prudent avoidance strategy and reduce their exposure to the radiation given off by their mobile.

Hands Free Kits

Currently, the cellular industry are encouraging the use of hands free kits, but cite their only advantage as being to offer greater freedom of use to the user, nothing else. The fact is they know the real reason users are buying them is because they think these kits protect them from radiation exposure. Recent tests have shown though that whilst exposure to the head is reduced by around 70 per cent (17), all that is happening is the radiation is being transferred to another part of the body which is potentially more vulnerable because it does not have the thickness of the skull to protect itself eg the waist or chest areas. MSI were so concerned about this, that it recently commissioned tests (18) which confirmed that of the 70 per cent still coming off the handset, 67 per cent is being absorbed into the user's body.

By letting users continue to believe that hands free kits make mobiles safer, the industry is in the enviable position of being able to placate users' fears, without having to change their stance that mobiles do not represent a health risk. Pushing the sales of health shields however, which after all have only one use, would be a different proposition and compromise their stance that mobiles are safe and the last thing they want to do is admit that. Whilst this strategy may help the cellular industry cover their position, MSI believes it morally wrong as some users may now even have increased usage as a result of their new found confidence in the safety of the product.

Non-Thermal v Thermal Effects

The NRPB and industry's position that mobiles are safe, is based on the facts that all handsets comply with current recommended limits, which are based on thermal considerations only. As you have probably already been made aware, the literature is full of published papers showing damage and biological effects at power levels which were set deliberately well below thermal thresholds and therefore by definition could not have been caused by thermal damage.

Even if we assume the thermal only argument to be correct, there are circumstances which the group should be aware of, where exposure exceeds even the thermal limits.

— Mobile users who wear metal rimmed glasses are intensifying the exposure to their eyes by 20 per cent and into the head by 6.3 per cent (19). According to statistics, anything up to 60 per cent of people in the UK wear glasses.

— Using a mobile in a vehicle can accelerate radiation levels by up to 10-fold due to a resonance effect (20).

— Cellular industry sponsored tests show that some current mobiles exceed recommended limits under certain operational conditions (21). For compliance purposes for instance, it is assumed that all mobile users will hold their phone in exactly the same way.

Remember also, all the aforementioned users who have complained of symptoms have been affected by a mobile phone which has been certified to comply with thermal exposure limits and are therefore safe according to the NRPB. By definition therefore, their symptoms could not have been caused by a thermal effect!

Patents

A national broadsheet late last year published an article highlighting the contradictory behaviour of the industry (22), when it published details of six patent applications owned by mobile phone manufacturers where the language used within the patent applications clearly indicated that more was known about health effects than the industry let on (23). One such application states that the purpose of the invention is "to prevent the health of the user from being injured", whilst another owned by Ericsson is for a warning alarm that is triggered when a user has reached maximum exposure levels.

The FEI have countered that these were just safety devices provided by designers for potential future changes in limits. If this was true, one might have expected the design to have been included in the original patent for the mobile itself. One might also have expected to see one of these issued by every manufacturer, not just the few. More significantly, the wording in the patent which is always very important (patent offices are extremely finicky about these things), would have had to state that the purpose of the invention was to ensure that the phone emissions stayed within any new future limits. None of the patents even allude to this. They all cite health reasons as being the only purpose of the device.

Many mobile handbooks also contain sections on radiation safety, which recommend users wishing to reduce exposure, to spend less time on the phone. All in all, not the sort of activity which supports their conviction in the safety of their own product.

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APPENDIX 14

Letter to the Committee Specialist from Mr Stephen Cox, Executive Secretary, The Royal Society

This consultation addresses two important issues: the processes and structures the Government uses to obtain and consider scientific advice; and the health impacts of mobile phones. With regard to the former issue, the Society has provided, and will continue to provide, advice to Government and Parliamentary committees. In particular, I would like to draw your attention to the two responses prepared for this inquiry to date: *The Scientific Advisory System* (June 1998) and *Scientific advice on GM foods* (April 1999) copies of which are enclosed[25]. Furthermore, the Society will shortly be publishing its submission on *Science and Society* to the House of Lords Select Committee which is also relevant to this consultation.

The Royal Society recognises the fundamental importance of the generic questions being addressed by the current inquiry on the use of scientific advice by Government. In particular we support the Chief Scientific Adviser's emphasis on the importance of integrity in the gathering and analysis of factual evidence, openness in the solicitation and interpretation of advice, acceptance of scientific limitations and uncertainties and the need to provide public explanations as to how advice has been applied during the development of policy.

Controversy associated with some scientific issues has undoubtedly increased with greater public access to information and, with it, calls for government intervention. If public policy on scientific issues is to be accepted, it is of paramount importance that the public have an understanding of and confidence in the underlying science. In this regard all scientific advice does not have the same authority. It is essential that the results of scientific research used in public policy meet the highest quality standards. This can only be ensured by the peer review process. Furthermore, it is also important to convey the concept of uncertainty and the limits of scientific understanding to a wider public. In the absence of accessible and reliable scientific information, the public may form their opinions based on the agendas and personal beliefs of special interest groups that are able to to exploit public concerns to their own ends.

We have not had the opportunity to review the evidence in detail. On the face of it, it is difficult to draw firm conclusions at present about the health hazard of mobile phones. We would support a careful epidemiological study in which alternative influences on health are examined alongside the use of mobile phones. As in all studies, thorough analysis of alternatives can lead to surprisingly robust conclusions.

We look forward to seeing your report.

17 June 1999

APPENDIX 15

Memorandum submitted by Dr G J Hyland, Department of Physics, University of Warwick, Coventry, UK and International Institute of Biophysics, Neuss-Holzheim, Germany

PERSONAL STATEMENT

Since 1985, I have been involved with the interaction of non-ionising, radiation—specifically microwaves—with living organisms, actively developing the novel ideas of H Fröhlich, FRS, who, 30 years ago, first predicted that adequately metabolising living systems themselves support a coherent microwave activity. During the last 18 months, I have been applying my findings to the question of potential health hazards posed by mobile telephones and their associated base stations.

I am recognised as an international expert in this field, and have published numerous articles and papers—dealing not only with the microwave sensitivity of living systems, but also with the emission from them of coherent, ultra-weak light (biophotons). I am regularly invited to speak at international conferences, at meetings of Professional Bodies (such as the Institution of Electrical Engineers), and on radio and television, both national and international. My work is frequently reported on in the Press, and has recently been the subject of articles and features in numerous international magazines, including the *New Scientist*.

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[25] Not printed.

Given my vantage point from theoretical biophysics, I believe that I am uniquely qualified to assess the problem in its entirety, thereby being able to offer invaluable insights that might not otherwise be available.

SUMMARY

Attention is drawn to the inadequacy of existing safety guide-lines governing the exposure of the public to radiation of the kind used in mobile telephony, and to the fact that the philosophy underlying the formulation of these guide-lines is fundamentally flawed.

This is because only established, reproducible effects are currently considered to constitute an acceptable basis for the formulation of safety guidelines; this restricts the effects against which some degree of protection is afforded to intensity-based heating. For, being independent of whether the irradiated object is dead or alive, they can be predicted with certainity.

Thereby excluded, however, are possible adverse health effects provoked by the ability of living organisms—and only living ones—to respond in an non-thermal way to aspects of this radiation other than its intensity—specifically its frequency—both the microwave carrier and the lower frequency amplitude modulations that characterise the digital signals employed by the GSM system. The dependence of these effects on the "aliveness" of the organism necessarily means that they cannot enjoy the same degree of reproducibility, as do those that are not so dependent. This does not mean, however, that they do not exist, or that they should be excluded from the formulation of safety guidelines; indeed, the very real possibility that they might trigger adverse health effects must be seriously considered. The empirical fact that such radiation is known to have deleterious effects on both the neurological and immunological functioning of living organisms—including humans—is consistent with this possibility.

Systematic experimentation is urgently needed, not only in order to be able to identify more precisely the parameters governing non-thermal influences of ultra-low intensity microwave (and low frequency modulated) irradiation of living organisms, but equally important, to ascertain the nature and severity of any adverse effects on human health thereby provoked. Some interim measures are identified to ameliorate the unnecessarily hazardous situation currently prevailing in the vicinity of the base stations that service the mobile phone network.

1. Existing safety guidelines governing exposure of the public to the radiation employed in mobile telephony are totally inadequate, and the philosophy underlying their formulation is fundamentally flawed.

2. Existing guidelines regulate only the intensity of the radiation in an attempt to protect the human body from adverse health effects which are known to be linked to intensity—namely, (a) the absorption of energy by biological tissue which, in the case of microwave irradiation, causes heating, or (b) the induction in the body of circulating electric currents, in the case of exposure to extremely low frequency (ELF) magnetic fields. Both these effects have been well understood for almost a hundred years, and always occur—irrespective of whether their radiated system is a living organism or a piece of inanimate matter. Existing safety limits are set [1] by restricting the intensity to ensure that the temperature rise, or induced electric currents are kept well below the thresholds of the onset of established bio-negative effects.

Although the existing safety guidelines are clearly necessary, they are quite inadequate. For they completely fail to consider the possibility of adverse health effects linked to the fact that living organisms—and only living ones—have the ability [2] to respond to aspects of technologically produced radiation other than its intensity, and, accordingly, can respond at intensities well below the limits imposed by the safety guidelines. A well-known example of this is the ability of a stroboscope—even at quite low intensities—to induce epileptic seizures.

3. The crucial discriminating feature of technologically produced radiation (whatever its intensity)—which is necessary if it is to carry information—is its coherence, the degree of which is significantly higher than that characterising radiation of natural origin, such as sunlight, to which Mankind has evolved a certain immunity. This immunity does not, however, extend to the much more coherent radiation of technological origin, to which we have only relatively recently been exposed. Coherence is a concept that is, of course, familiar in the context of lasers, whose light, due to its coherence, is in-step (in phase) with itself, and thus particularly "pure" in frequency (colour), and hence far more potent than that from an ordinary lamp. This potency still obtains in the case of the much less intense radiation emitted by other devices—in particular, those employed in mobile telephony—whose coherency greatly facilitates its discernment by the living organism against the level of the ever-present (incoherent) thermal background emission appropriate to its own physiological temperature—ie the coherence of the radiation significantly increases its potency to affect living organisms.

4. The ability of living organisms to respond to external coherent radiation arises because they are electromagnetic instruments of great and exquisite sensitivity, that themselves support a variety of highly organised, coherent electrical activities, each characterised by a specific frequency, which play important roles in maintaining the organisation and control of the living organism [3]. This natural (endogenous) coherent electrical activity "preconditions" the living organism to be highly sensitive to external, coherent

electromagnetic radiation in a non-thermal way that is not primarily dependent on its intensity (brightness), but rather, on its frequency (colour) which, as already noted, is sharply defined.

5. The reality of adverse bioeffects not primarily dependent on intensity is well illustrated by the ability (already mentioned) of a light flashing at a certain frequency (between 15 and 20 times per second) to induce epileptic seizures in certain susceptible people. It is the digitisation into regular pulses that effectively makes the light (which is naturally incoherent) coherent—the regularity of the pulses evidently being close to that of an important brainwave activity, interference with which provokes the seizure. It is not so much a question of the amount of energy absorbed from the irradiating field (which is determined by its intensity, or brightness) but rather the information transmitted by the (coherent) regularity of its flashing—at a frequency that the brain"recognises", because it matches, or is close to one utilised by the brain itself.

6. Somewhat less well known is the fact that the microwave signals used in the digital GSM system of mobile telephony similarly "flash" 217 times per second, and that this flashing is punctuated at the much slower rate of 8.34 per second—a frequency that happens to lie in the range of the important alpha brainwaves! Given that both light and microwaves belong to the same electromagnetic spectrum, differing only in their frequency and degree of coherence, there is no reason to suppose that the deleterious effect of a flashing visible light does not extend to microwave radiation flashing at an equally low frequency since this can easily penetrate the skull. (The effect of this punctuated flashing can easily be detected as a crackling sound when a turned-on mobile phone handset is held near a switched-on radio receiver). That it is surely unreasonable to suppose that our brains should somehow be immune to this electromagnetic aggression is pointedly emphasised by the prohibition on the use of mobile phones in aircraft, on the grounds that their signals might interfere with the plane's control systems. Given the infinitely greater electromagnetic sensitivity of the alive human organism, it would be paradoxical if the same radiation did not similarly interfere with our own neural processes—whether we are in the (far) field of a base station mast, or the (near) field of a phone antenna.[26]

7. Even less well known is the fact that adequately metabolising living organisms can themselves support another kind of organised (coherent) electrical activity, the frequency of which happens to fall in the microwave band [2], to which the carrier frequencies used in mobile telephony belong. Again, just as a relatively slowly flashing (visible) light can affect certain (electro-chemical) neurological processes characterised by the same frequency, so living systems have a preconditioned sensitivity also to ultra-weak microwave radiation; thus, in addition to a sensitivity to the low frequency (8 Hz) punctuation of the microwave "flashes" used in mobile telephony, the human organism could well be sensitive also to the "colour" of these flashes, ie to the microwave carrier frequency. Accordingly, there is the possibility [4] of either a resonant amplification (perhaps to a dangerously high level) of an internal biological electrical activity, or interference with it, resulting in its degradation. It is also possible for external radiation to augment the naturally prevailing level of metabolism, and, after a sufficient time, to thereby effectively "switch on" an internal microwave activity which Nature did not intend to be on; this requires a certain minimum threshold intensity that is, however, well below thermal levels.

8. It is thus apparent that existing safety guidelines (which address only thermal effects dependent on the intensity of the field) do not, and cannot protect against any adverse health effects that might be allied specifically to the wave nature of the radiation, such as its frequency ("colour"), coherence (purity of colour"), etc. Clearly there is "another side of the coin" to be taken into account—just as, in addition to photography (an intensity dependent process), there is also holography (a process intimately related to the wave nature of light, specifically its phase). It must be stressed, however, that these other possibilities depend on the organism being alive; for it is through its vitality that it is "sensitised"—just as a radio has to be switched on before it can respond to a signal. Effects due solely to intensity, by contrast, do not require the organism to be alive—ie are not specific to living systems; for example, a microwave oven will cook a piece of (dead) meat, just as it will a (living) animal.

Current safety guidelines thus fail to take into account the most discriminating feature of all—namely the "aliveness" of the organism being irradiated!

9. In turn, whilst the aliveness "opens" the system to certain features to which it would not otherwise be sensitive, it also means, however, that any particular non-thermal effect cannot be predicted to occur with the same absolute certainty as that with which thermal effects dependent solely on intensity can—against which existing safety guidelines attempt to protect. In the case of these non-thermal effects of microwave radiation, even the occurrence of the primary, initiating interaction cannot be predicted with certainty, since unlike the intensity-based heating effect, it depends on the "aliveness", eg metabolic rate of the irradiated subject, which, in general, varies from person to person. The situation can be likened to the difference between putting one's hand in a fire (which can be definitively predicted to cause burning), and having contact with a 'flu virus, the consequence of which cannot be uniquely predicted—whether one catches the 'flu depending, amongst other

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[26] In this connection, it should be pointed out that when a handset equipped with discontinuous transmission (DTX) is in listening mode, there is an even lower frequency pulsation at 2 Hz. This is of particular concern since it falls in the range of the so-called "delta" brain-waves which, if present in the EEG of awake adults, are symptomatic of neural pathology, and therefore should not be promoted by exposure to radiation of this frequency. On the other hand, brain activity at this frequency also characterises the important REM stage of sleep, so that reports of tiredness experienced during the day are perhaps not surprising. In children, by contrast, delta waves are normal, and thus, again, should not be disturbed by external interference.

things, on the robustness of one's immune system, which, of course, varies from person to person; similarly, in the case of an epidemic, not everyone succumbs.

This, of course, has serious implications on the acceptibility of the philosophy underlying the current formulation of safety guidelines by the National Radiological Protection Board (NRPB) and other regulatory bodies—namely, that they can be based only on established, reproducible effects. The intensity-based heating effect of microwave radiation, of course, conforms to this criteria, since being independent of whether the irradiated organism is alive or dead, it can be predicted to occur with certainty. Necessarily excluded, however, are effects contingent on the "aliveness" of the human organism—in particular, the non-thermal effects discussed above, that, in principle, cannot enjoy the same degree of reproducibility; this does not mean, however, that they do not exist! Accordingly, the prevailing philosophy must be considered to be fundamentally flawed!

The same is true of statements to the effect that "there are no established health hazards of radiation of sub-thermal intensity", since, unlike thermal effects, only the possibility of any initiating non-thermal influence can be meaningfully spoken of. The traditional understanding of "cause and effect" is thus no longer appropriate here, and must be replaced[5] by the more modern idea of "signals and responses"—a concept familiar in sociological contexts, where the response of different people to the same signal can vary enormously, particularly if in one person it "strikes a raw nerve", that is absent in another.

It is thus clear that effects not allied to intensity inevitably "slip through the net" of existing safety guidelines, which, of course, raises the question as to how a more comprehensive level of safety might be ensured. Before considering this, it is necessary to assess the status of evidence—both theoretical and experimental—consistent with the potentiality of living organisms to be adversely affected by ultra-low intensity radiation.

10. Firstly, it is to be noted that the preconditioned hypersensitivity of adequately metabolising living organisms to ultra-weak microwave radiation of a particular frequency is a quite general prediction of modern biophysics[2], reflecting the self-organising ability of open, dissipative systems in the non-linear regime far from thermodynamic equilibrium, whereby once the rate of metabolic energy supply exceeds the rate at which the system can turn it into heat, a certain fraction of this energy is (non-thermally) channelled into a highly organised (coherent) collective vibration of the whole system, wherein it is stored and effectively protected against dissipation—the frequency of this vibration being in the microwave band.

Secondly, much experimental evidence has accumulated over the past 25 years that is consistent not only with the existence[6] of this endogenous microwave activity, and with associated non-thermal, highly frequency-dependent influences[4]—such as, for example, alterations in the growth rate of *E. coli*[7] and yeast[8], synchronisation of cell division[9], the "switch-on" of certain genetic processes[10], alteration in the activity of important enzymes[11], etc—but also with the fact that other organised electrical activities in quite different frequency ranges, such as brainwaves[12], can likewise be influenced in a non-thermal way by external fields (amplitude), modulated to a similar frequency; in addition, there are numerous reports of other non-thermal influences of the radiation of the kind used in mobile telephony, such as effects on human blood pressure[13], depression of the immune efficiency of human leukocytes (white blood cells)[14], increases in the permeability of the blood-brain barrier[15], increases in calcium efflux from brain tissue[16], and most dramatically, a significant increase in the mortality of chick embryos[17].

Finally, there are the numerous reports (that display a remarkable consistency world-wide) of adverse health effects experienced both by users of mobile phones and by people resident in the vicinity of the associated base stations, the most common complaints being those of a neurological nature, such as effects on short-term memory, concentration, learning, sleep disorders and anxiety states[18], as well as increases in the incidence of leukemia[19].

It is clear that the laboratory findings[27] referred to above are, in general, consistent with the reported adverse health problems. Given this degree of circumstantial evidence, research effort must now be directed towards understanding the extent to which the reported adverse health effects can be considered to be actually initiated by some primary non-thermal influence of an ultra-low intensity external electromagnetic field on the human organism, and, further, to consider whether adverse health effects other than those already reported might also be provoked.

The present situation is summarised in the attached Figure.

11. Taken individually, the evidence from each of the four sectors might well be considered less than compelling, but when considered together, a rather interconsistent picture emerges from which it is clear that the issue of non-thermal effects can no longer be responsibly dismissed as an epiphenomenom, but is indeed a reality which cannot be reasonably denied—a reality which mandates firstly its recognition by regulatory bodies, and secondly, that serious and urgent attention be given to how the public might be better protected

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[27] It should be stressed that experimental difficulties encountered in independent attempts to reproduce these findings are not unexpected, but indeed reflect the non-uniqueness in the response of living organisms mentioned above. It must be appreciated that not only are these experiments extremely difficult in themselves, but also that the relatively large numbers of variables involved in the full characterisation of the living organism (not to mention deterministic chaos[20]) militates against the realisation of the identical conditions necessary to ensure reproducibility.
In many cases, positive results were only obtained, with considerable patience and effort, after many initial failures. Since the odds are so stacked against a positive result, the realisation of one must be considered to be rather significant.

against any associated adverse health effects, so that the benefits of modern telecommunication technology can be enjoyed with a higher degree of safety than is currently the case. Before this can be done, however, much more research into these subtle effects is required—specifically:

A. Further studies at the level of the primary interaction of ultra-low intensity microwaves (including pulsed ones) with living organisms—along the lines already pursued in the laboratory, using lower forms of life for experimentation[7-11]—aimed at obtaining a much better understanding of the ability of such radiation (of sub-thermal intensity) to influence, non-thermally, biological processes both at a cellular and sub-cellular level, addressing, for example, the magnitude of the (sub-thermal) threshold intensity and duration of irradiation necessary to achieve the switch-on of various processes, and the dependence of these processes on the frequency of the radiation.

B. Much needed physiological studies, to establish the nature and extent of any adverse effects on human health provoked by the primary non-thermal influence of ultra-low intensity radiation on the living organism [12-17].

12. Meanwhile, several courses of action can be identified that would go some way to ameliorating the (unnecessarily) hazardous situation currently obtaining in the case of base stations:

(i) Ensure that the field strengths to which the public is so indiscriminately and involuntarily exposed are kept well below the threshold values referred to above, which are 1,000 times lower than thermal levels, being of the order of *microwatts/cm*^{2} *(=*μ*W/cm*^{2}*).*

This will, of course, also lower the energy in each pulse, and can be achieved either by locating the antennae on much higher masts, or by introducing an exclusion zone, such as the one of 500 metres recommended (but not legally enforceable) by the Association of Local Governments of New South Wales (NSW), Australia; clearly, mast height can be traded against the extent of any exclusion zone.

It may be noted, in connection with NSW, that the safety limits there recommended (but again not legally enforceable) are the most stringent in the world—being 1,000 times lower than 1μ*W/cm*^{2}. By comparison, the NRPB value of *3,300*μ*W/cm*^{2} is one million times higher! Furthermore, the NRPB value is more than seven times higher than that (*450*μ*W/cm*^{2}) of the International Commission on Non-Ionising Radiation Protection (ICNIRP [1]) who advise the World Health Organisation, whilst the EU has recently recommended a value of 10μ*W/cm*^{2}.

(ii) Prevent localised areas of unnecessarily high fields by prohibiting the future erection of clusters of masts in the same vicinity, and requiring that existing clusters be replaced by a single tall mast serving the various companies. In considering Planning Applications, attention should be given to the proposed site of a mast in relation to the local topography, so as to ensure that in hilly terrain, for example, there are no homes, schools, hospitals or any other public buildings that are occupied for any appreciable period of time on a level with the emitting antennae. Furthermore, the antennae distribution on the mast should be such that the highest possible emission in any direction (taking into account the maximum call traffic) is, in publicly accessible areas, well below the *1 microwatt/cm*^{2} threshold value.

(iii) Remove from the digital signal any low frequency (amplitude) modulations that fall in the range of the human brainwaves.

18 June 1999

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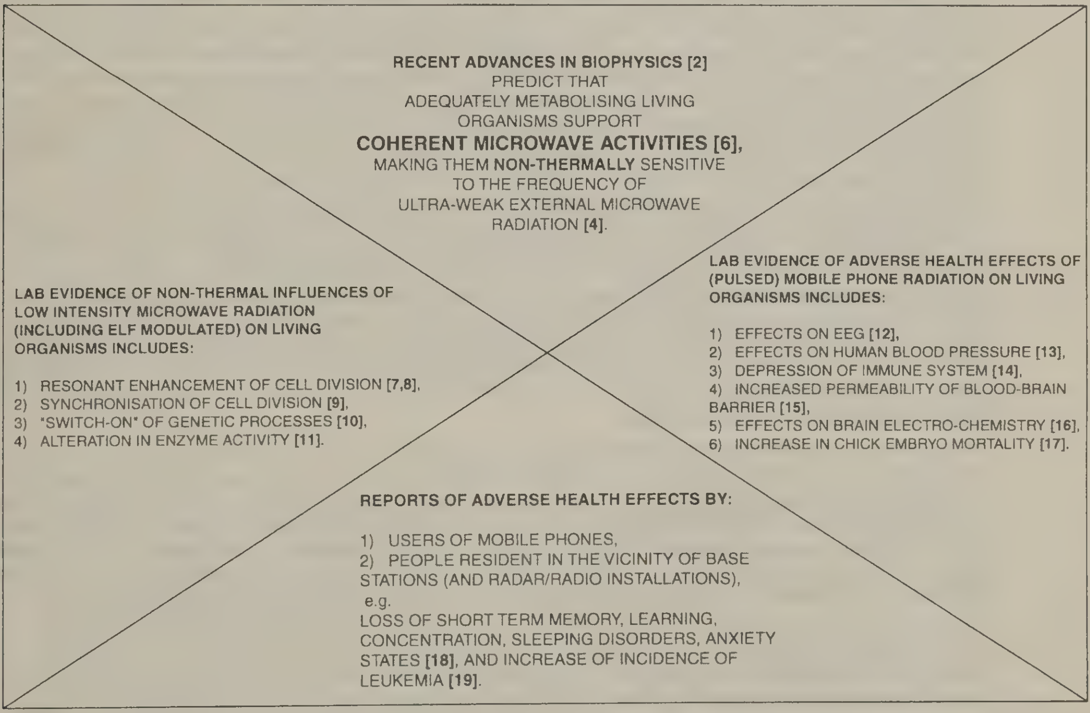

RECENT ADVANCES IN BIOPHYSICS [2]
PREDICT THAT
ADEQUATELY METABOLISING LIVING
ORGANISMS SUPPORT
COHERENT MICROWAVE ACTIVITIES [6],
MAKING THEM **NON-THERMALLY** SENSITIVE
TO THE FREQUENCY OF
ULTRA-WEAK EXTERNAL MICROWAVE
RADIATION **[4]**.

LAB EVIDENCE OF NON-THERMAL INFLUENCES OF LOW INTENSITY MICROWAVE RADIATION (INCLUDING ELF MODULATED) ON LIVING ORGANISMS INCLUDES:

1) RESONANT ENHANCEMENT OF CELL DIVISION **[7,8]**,
2) SYNCHRONISATION OF CELL DIVISION **[9]**,
3) "SWITCH-ON" OF GENETIC PROCESSES **[10]**,
4) ALTERATION IN ENZYME ACTIVITY **[11]**.

LAB EVIDENCE OF ADVERSE HEALTH EFFECTS OF (PULSED) MOBILE PHONE RADIATION ON LIVING ORGANISMS INCLUDES:

1) EFFECTS ON EEG **[12]**,
2) EFFECTS ON HUMAN BLOOD PRESSURE **[13]**,
3) DEPRESSION OF IMMUNE SYSTEM **[14]**,
4) INCREASED PERMEABILITY OF BLOOD-BRAIN BARRIER **[15]**,
5) EFFECTS ON BRAIN ELECTRO-CHEMISTRY **[16]**,
6) INCREASE IN CHICK EMBRYO MORTALITY **[17]**.

REPORTS OF ADVERSE HEALTH EFFECTS BY:

1) USERS OF MOBILE PHONES,
2) PEOPLE RESIDENT IN THE VICINITY OF BASE STATIONS (AND RADAR/RADIO INSTALLATIONS),
e.g.
LOSS OF SHORT TERM MEMORY, LEARNING, CONCENTRATION, SLEEPING DISORDERS, ANXIETY STATES **[18]**, AND INCREASE OF INCIDENCE OF LEUKEMIA **[19]**.

APPENDIX 16

Letter to the Clerk of the Committee from Mr Peter Methuen, Director, Latitude 52 Ltd

I understand there is currently a committee sitting studying the microwaves from mobile telephones. May I please make the following contribution which, I hasten to add, is not scientific and merely anecdotal.

Some years ago I purchased a microshield case for my mobile telephone. Amazingly, the headaches I had been experiencing ceased. Of course, the headaches could have been caused by something else but I am pleasantly surprised that I no longer experience headaches.

If this is the result of using a microshield, then indeed it is money well spent. As a result, I recommend to everybody that they should consider using a shielded case on their mobile telephones.

17 June 1999

APPENDIX 17

Memorandum submitted by Mr Roger Coghill, Coghill Research Laboratories, Pontypool, Gwent

DEFICIENCIES IN THE DELIVERY AND ASSIMILATION OF ADVICE TO GOVERNMENT ON THE ISSUE OF MOBILE TELEPHONY HANDSETS AND BASE STATIONS

Introduction

With a claimed 13 million users in the UK alone, the issue of cellphone handset radiations has become one of enduring media and scientific interest. The intricacies of its technology however means that the public are not familiar with the levels and quality of radiations from such instruments, acknowledged to be the most radiative domestic appliances yet in largescale public use, operated close to the human brain at all ages and in all echelons of society. I say at all ages because I am including the new generation of wireless baby monitors in the category, even though they operate at different frequencies and power densities. Accordingly, the public and Hon Members alike are left confused by an openly conflicting argument between authorities in the field on both sides of the Atlantic, fanned by continuing media attention and often misrepresentation.

This ignorance extends to many Hon Members, few, if any of whom are not electronics or radio engineers or any biologists specialising in bioelectromagnetics. The Government relies substantially on its own experts and in particular on the advice of the NRPB, instituted in 1970 and extended in mandate in 1974 to cover non-ionising fields and radiations.

However, this body spends less than 10 per cent of its £15 million annual income, derived half from arguably suspicious industrial sources, on research into non-ionising electromagnetic fields and radiation. In consequence, it rarely produces its own research, relying on its Advisory Group's literature reviews; indeed of the 145 papers in the NRPB 1997–98 Annual Report, only 13 were on non-ionising EM fields and radiation, and of these only three were actual research, the rest being book reviews or literature reviews and not peer reviewed.

Examination of these literature reviews of the NRPB reveals serious deficiencies, in particular that of the Advisory Group in 1992 and of Dr John Stather in 1997. For a detailed critical analysis of these see Report to the Cork City Council on behalf of CARA by this laboratory dated June 1999.

In the issue of mobile telephony, the present advice of the NRPB is that only thermal limits are considered, and on this basis most (but not all) cellphones are within these guidelines. Similarly there is no recommendation to limit base station antennae exposures below thermal limits nor to advise the public of non thermal potential risks during a period while large-scale research programmes are investigating this possibility. (The WHO research initiative is not prioritising any research into base station health hazards, which may prove an error of judgement).

Nevertheless, in the scientific community there is a serious lack of consensus arising out of studies pointing to important and adverse sequelae from excessive cellphone use, or indeed from RF/MW radiations in general. Our recent presentation to the Northern Ireland Assembly at Stormont on behalf of NIFATT listed around 50 such studies, all peer reviewed, in the scientific literature. Though their existence is acknowledged by NRPB, their conclusions about them are invariably negative to the point of suspicion, and any inexpert reader could be misled by the interpretations, both by commission and omission, placed upon them by the NRPB and its Advisory Group (whose composition has changed substantially since formation).

In the UK the lack of attention to bioelectromagnetics science in British Universities has meant that out of 325 full members world-wide in the principal society of this science (the Bioelectromagnetics Society) there are only four full members from British Universities and only 13 full members in total, of whom five are from NRPB, the National Grid Plc, and Government Defence agencies. So far as I am aware the NRPB do not attend or contribute to the European equivalent, the European Bioelectromagnetics Association. This means in turn there are no alternative voices from the academic world, and those which have been briefly raised have soon become quiet. At Cambridge the only major study (Lacy-Hulbert, Hesketh *et al*, 1996) was utility funded and subsequently found to be fundamentally flawed. When these gross errors were pointed out by other peer reviewed journals the criticisms were left unanswered. This illustrates how the power utilities have in the past been largely responsible for funding, but that they have chosen study designs unlikely to answer the questions raised. The same criticism applies to the global cellphone industry, which has been concentrating on cell and animal studies, when the need is for epidemiology. For example, we had to conduct our own user survey in order to ascertain how many users used their cellphones for more than two hours a day. The cellphone industry refused to provide such information. Similarly the Institution of Electrical Engineers (IEE) have as yet made no formal statement on the health effects of RF/MW radiations.

The NRPB reviews sometimes omit important studies not convenient to their views. For example, in 1996, our laboratory published in the European Journal of Cancer Prevention a study of childhood leukaemia which identified a strong dose-response relationship between the electric component of the ELF electromagnetic wave and this disorder. It remains the only measured electric field study of any quality even today. It is supported by many other studies at a cellular and live whole animal level, and by the theoretical treatments of scientists (Ross Adey, Blank, Liboff), well respected in the field. Yet the NRPB refuse to acknowledge its existence, on the grounds that there may (and only may) have been selection bias in case or controls. At the same time the NRPB include for review studies (eg Myers, Clayden *et al*, 1990) whose authors admit these have only an 18 per cent chance of detecting a difference between cases and controls. There is an ELF component in the emissions of all cellphones.

Similar examples exist in the NRPB reviews of mobile telephony handsets and base stations. For example the 1989 study of immune system competence by three Chinese Universities reporting depressed phagocytosis among a sample of over 1,000 young persons living near RF/MW towers is scarcely mentioned (and mis-referenced) by the NRPBI. In the 1992 Advisory Group Review the tendency is to reference negative studies but not positive ones, so the reports by Kues, Elder *et al*, 1993 that MW exposures of the primate eye showed damage in the cases but not the controls is not referenced, whereas other negative reports are (see paras 59, 63). On many occasions one might quarrel with the Group's interpretation of studies.

As a body mandated to advise not only industry but also the public, the NRPB's conduct over the years has been clearly lacking in communication. Though there are many discussion programmes on the cellphone health issue, the NRPB refuses often to appear in the media or to defend its position other than by written statements to be read out. This has the effect on the public of lowering the NRPB's credibility. The NRPB is not well respected by the scientific community either: it was described by Professor Ross Adey as "dinosauric" in one BBC Scotland programme. Its advice stands out as being among the most lax (from the protective point of view) of all the world's regulatory authorities, being as much as 16 times less critical than other high frequency standards, guidelines and limits. Moreover, the advice is not clear to readers of its document, being expressed, eg in graphical rather than numeric form, or by formulae rather than specific numbers.

Moreover, the NRPB's advice is self-inconsistent with its own premises: if energy deposition is the ruling parameter then the energetic equivalent of the NRPB's electric field investigation level (eg 12,000V/m at 50Hz) is not the same as the magnetic component (1,600microTesla at 50Hz).

RECOMMENDATION

It is our recommendation that the non-ionising research arm of the NRPB be removed from the Board's mandate and that a new and conspicuously independent body be created including reputable bioelectromagnetic scientists such as myself who, though they may not be considered independent by all parties, are at least not aligned to industry and can demonstrate complete and continuing familiarity with the science. This new body should be financed to the extent of at least £5 million for research each year by a levy on the grotesque profits of the power utilities and telecommunications industry. Only by this means will the UK develop its expertise in bioelectromagnetics, where presently it is sadly lacking, a science whose study is affecting 100 per cent of the community, and be seen as credible both by Members of the House and by the public at large.

15 June 1999

APPENDIX 18

Supplementary memorandum submitted by Mr Alasdair MacLean Philips, Director, Powerwatch

This follows my main Memorandum submitted and acknowledged on 14 June 1999.

I have just purchased and received the Proceedings from the "Exposure Metrics and Dosimetry for EMF Epidemiology" International Workshop, held at the NRPB in September 1998.
[in: Radiation Protection Dosimetry, Vols 83, Nos. 1-2, 1999. ISBN 1 870 965 61 2]

I referred to this in my main Memorandum as follows:

> 3.12 . . . Last Autumn there was a scientific meeting of the WHO EMF Project on future EMF Metrics which held at the NRPB. About 45 people, including industry representatives and a number of researchers who had not got any EMF related research experience, were invited. I repeatedly asked Drs McKinlay and Stather if I could attend and they refused. I then contacted Dr Mike Repacholi, Head of the WHO project, and received the following reply:
>
> "There will be further meetings without the restrictions placed on the NRPB meeting that will allow you to provide your input. I have asked my secretary to place you on our mailing list of future meetings. Yours sincerely, Mike Repacholi."

I now attach as an Appendix three pages [pp iii, 193 and 194] from these Proceedings. Please note that of the 49 participants, 14 (marked*) are listed as directly representing the mobile phone and electricity industries.

Please also note on page (i) that although this was an NRPB-hosted WHO meeting to discuss the future of EMF epidemiological measurements, the meeting is listed as receiving funding from: Mobile Manufacturers Forum (Alcatel, Ericsson, Mitsubishi, Motorola, Nokia), the GSM MoU Association, and The National Grid Company plc UK.

I find this an inappropriate way to fund such an influential public interest scientific research meeting, especially as critical voices like mine were refused invitations to attend and contribute to the debate. I played a major role in getting ELF electric field measurements added to the UK Childhood Cancer Study in the face of opposition from the NRPB who has said that it was not possible to meaningfully measure human electric field exposure [I would be happy to give oral evidence on this]. In the light of my experience in both designing EMF measuring instruments and carrying our epidemiological research I find it disturbing that I was excluded from this workshop which discussed what the measurement metrics should be for future EMF epidemiology. It may be that industry funding played a part in my exclusion.

17 June 1999

EXPOSURE METRICS AND DOSIMETRY FOR EMF EPIDEMIOLOGY PROCEEDINGS OF AN INTERNATIONAL WORKSHOP NATIONAL RADIOLOGICAL PROTECTION BOARD, 7–9 SEPTEMBER 1998

Conference Organisation

Professor Sir Richard Doll, Imperial Cancer Research Fund—Cancer Studies Unit, Oxford, UK Conference Chairman and Programme Organiser.

Dr A F McKinlay, National Radiological Protection Board, Chilton, UK, Conference Co-ordinator and Programme Organiser.

Dr M H Repacholi, World Health Organisation, Geneva, Switzerland, Programme Organiser.

Ms S Bullock, National Radiological Protection Board, Chilton, UK, Conference Administrator.

Chairpersons

Professor J H Bernhardt, Institut für Strahlenhygiene, Oberschleißheim, Germany, Professor M Grandolfo, Instituto Superiore di Sanità, Rome, Italy.

Professor M Harrington, Institute of Occupational Health, Birmingham, UK.

Professor T Meade, Wolfson Institute of Preventive Medicine, London, UK.

Rapporteurs

Mr S Allen, National Radiological Protection Board, Chilton, UK.

Professor P Buffler, University of California, Berkeley, USA.

Dipl.-Ing R Matthes, Institut für Strahlenhygiene, Oberschleißheim, Germany.

Dr M McBride, British Columbia Cancer Agency, Vancouver, Canada.

Organisers and Sponsors

National Radiological Protection Board, World Health Organisation, and the International Commission on Non-Ionising Radiation Protection, with funding from Mobile Manufacturers Forum (Alcatel, Ericsson, Mitsubishi, Motorola, Nokia), GSM MoU Association, and The National Grid Company plc UK.

EXPOSURE METRICS AND DOSIMETRY FOR EMF EPIDEMIOLOGY PROCEEDINGS OF AN INTERNATIONAL WORKSHOP NATIONAL RADIOLOGICAL PROTECTION BOARD, SEPTEMBER 7-9 1999

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APPENDIX 19

Memorandum submitted by the Medical Research Council

The MRC is not currently supporting any research into the implications for health of the use of mobile phones, nor are we at present funding any relevant work on radio waves or non-ionizing radiation. We are not therefore well-placed either to comment on the extent to which there are grounds for health concerns, nor on the opportunities for new technologies to reduce health risks.

The MRC is responsive to national health needs, and has relationships with a variety of partners (including the Department of Health and the National Radiological Protection Board) to help draw responses to those needs. As such, we welcome good quality research proposals in this area. Any such proposals are evaluated through the established peer-review process, in competition with proposals in other areas.

In relation to the quality and nature of the scientific advisory system, we would not want to add anything to our earlier submissions to the Committee's original inquiry last Spring[28] and to the more recent inquiry in the context of GM foods[29].

21 June 1999

APPENDIX 20

Memorandum submitted by British Telecommunications plc

1. INTRODUCTION

BT is one of the world's largest telecommunications companies and has a turnover of £18.2 billion. BT employs almost 125,000 people and has growing interests in most regions of the world. BT's mobile telephony interests represent a significant and growing proportion of its turnover and, in the UK, this interest is exercised by its joint venture BTCellnet (turnover £1.4 billion), one of the UK's major mobile operators, and through its many international mobile joint ventures around the globe. BT's share of UK and overseas mobile ventures "equity revenue", based on its shareholding, is £2.5 billion.

BT is an active member of the Federation of the Electronics Industry (FEI) and BT's general approach is in line with that set out in the FEI's written submission on this subject. This submission is provided in response to the Committee's direct invitation for BT to present its own memorandum; it reflects BT's approach and views within the overall framework set out in the FEI submission.

2. MAIN POINTS OF BT'S EVIDENCE

As set out above, this document does not seek to repeat points directly covered in the FEI response. Against this background, BT's position may be summarised as follows:

Health and safety issues are of prime importance to BT. We are very conscious of our responsibility to employees, customers and other stakeholders; this responsibility sits at the very heart of the company ethos.

The NRPB and other reputable agencies have advised that there is currently no demonstrable scientific evidence that the use of mobile phones represents a risk to health through exposure to Radio Frequency (RF) waves. This belief stems from the consensus of responsible and independent scientific research undertaken over many years and in many countries, as set out in the FEI submission to the Committee. BT sees no reason to disagree with this view.

But there is no irrefutable evidence that there will never be a problem. Therefore BT believes that there is no room for complacency and the company recognises, as does the FEI, the need for continuing, relevant and high quality research to ensure this issue is subject to the most up-to-date and rigorous scientific scrutiny.

Within BT, we are impressed by the work of the World Health Organisation (WHO) EMF Project which covers the medical and scientific aspects of mobile phone safety. The WHO Project performs an excellent role in co-ordinating and interpreting research, sharing the results and, most importantly, recommending what further research needs to be done at a global level. Indeed, WHO's exemplary approach on this topic could well be utilised with benefit in other areas of health concern.

BT strongly supports the work carried out by the NRPB and is conscious and supportive of its links with the WHO Project which we view as essential. BT is represented on the WHO EMF Research Committee and has good links with NRPB; BT also monitors relevant research publications.

BT takes seriously any potential health concern, irrespective of current scientific opinion on the issue. Indeed, BT recognises that quoting scientific authority, whilst very important, is not necessarily the complete answer to the question of enhancing public trust in products and services. Transparent and impartial decision-making, following wide consultation with relevant interest groups, is recognised as an important part of gaining trust and demonstrating integrity. This philosophy will continue to underpin the company's approach on this issue and indeed, any other issue with health implications. BT believes that Government also has a role to play in co-ordinating communications to stakeholders on this subject by, as an example of one possible option, the enhancement of the current NRPB role.

BT appreciates the importance of research conducted independently of industry interests and is willing to support an independent body, perhaps linked to NRPB, to receive and manage research funding and to allocate funds to quality research proposals, with appropriate safeguards.

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[28] Not yet reported.

[29] HC 286-II.

3. Quality and Objectivity of Advice Provided at Present

BT welcomes this Inquiry and supports the need for Government and the public to be provided with the best possible scientific advice.

We acknowledge the responsibility and the competence of the NRPB to provide advice and guidance to both Government and the public. BT agrees with the NRPB's assessment that there is no known cause for concern but that more research is required in order to ensure the most up-to-date, complete and relevant scientific information is available to all stakeholders.

BT also recognises the global perspective and acknowledges the global role that scientific investigation should play in advising stakeholders and shaping policy.

4. Suitability of Current Procedures and Obtaining Quality Scientific Advice

BT supports the view that judgements should be based on the totality of sound scientific evidence, irrespective of the findings of any one study. Such judgements should factor in established and accepted standards of best scientific practice, including, for example, peer review and replicability of results.

BT believes it is vital to communicate with openness and integrity. BT will continue to do this through its own channels and through its continued contribution to relevant industry mechanisms, aimed at increasing stakeholder understanding through open, effective and unbiased communication.

5. Processes for Assessing Scientific Advice in Policy Making and Regulation

BT endorses the current process which has statutory bodies such as the NRPB and the ETSI responsible for setting relevant guidelines and standards.

BT supports the principle of greater discussion and co-operation with industry, Government, its advisors and other stakeholders to ensure best possible advice and scientific assessment is achieved.

6. Extent to Which There are Grounds for Health Concerns

BT accepts the NRPB statement that "At present, the international consensus in the world-wide scientific community is that there is no demonstrable evidence of a health risk."

However, BT also supports the need for ongoing good quality research to ensure that the best possible, up-to-date, scientific data continues to be made available.

7. Opportunities for New Technologies to Reduce Health Risks

Research continues to provide reassurance of the suitability of current safety standards and guidelines. Mobile phones sold by BT are currently designed to operate well within these parameters.

However, BT would, in principle, support any opportunities for new technologies to provide further reassurance to any potential public concerns. However, any such activity must guard against the possibility of confusing or undermining the current level of public assurance in our compliance with current safety standards.

In particular, whilst BT does not believe "car kits", "headsets" or other accessories are essential purely for health reasons, it respects the use or otherwise of such accessories, for whatever reason, as a matter of personal choice.

BT recognises the benefit of hands free kits (eg headsets) being available to people who are concerned. Even if there were no risks, anyone who has concerns could be encouraged to use them. All models currently sold by BT UK sales channels have available such kits.

8. Need for Further Research

As stated above, BT welcomes ongoing research in order that stakeholders continue to receive the benefit of the most complete and up-to-date scientific thinking on RF technology.

BT, through its membership of the FEI and other relevant international organisations (eg GSM association), will continue to support the industry in new research initiatives, as part of the many global efforts and initiatives (eg the World Health Organisation and European Union programmes).

June 1999

APPENDIX 21

Letter to the Committee from Mr Stewart Anthony Fist

This submission on the question of Mobile Phones and Health is much longer than you would like—but the questions you are dealing with are not simple ones that can be answered in a few pages.

I am express-mailing the original copy and appendices, and faxing just the main discussion paper.

I live in Australia but will be on the east coast of Canada and the USA during the last week of July and first week of August speaking at a couple of conferences on the question of how the science is manipulated. I could fly to the UK at this time if you feel you could benefit from substantial discussions on the matters raised here.

11 June 1999

Memorandum submitted by Mr Stewart Anthony Fist

INTRODUCTION

I write a weekly column on the social, economic, political and medical issues of telecommunications and technology for *The Australian (News Ltd)* newspaper in which I regularly raise cellphone health issues. I believe I am the only columnist to do this regularly in a mainstream newspaper in the world.

I also write a regular monthly column specifically on cellphone health research in an Australian electronics trade-hobby magazine, *Electronics Australia*. Again, I believe this to be the only column of its type in the world.

I am an independent investigative/technical journalist and a regular columnist for a number of Australian newspapers and magazines, with a background in television current affairs. My initial profession was optometry, and I have also been involved for many years in meta-research into environmental and health issues.

I was employed at one time by public relations firm Hill & Knowlton as a specialist consultant in these areas, and later established a company (Imform) which conducted scientific and environmental meta-research—preparing reports which culled and consolidated the evidence produced by scientific research into various subjects.

My company, Special Projects Pty Ltd, (trading as Imform Information Brokers) was contracted to Australian companies and government agencies in the mid-1980s, both directly and through local public relations companies. We used the first-generation of time-share on-line information retrieval systems (before PCs) which linked us to the giant US databases Dialog and Orbit via Pacific phone and X.25 connections.

Our expertise was in gathering and examining the evidence for and against such health and environmental problems as: cigarettes and tobacco; asbestos-fibre exposure; DDT; PCBs exposure and disposal; 245-T/Agent Orange (and dioxins); food colourings, additives and preservatives; and various similar health concerns. Mostly we were advising the companies and agencies concerned with the manufacture and/or sale of these products.

I now regret much of my involvement here, because most of this research was used to cover-up serious health problems. I no longer have any association with public relations or in meta-research for any company. However I do have an insight into how these companies and industry sectors organise their anti-environmental or anti-consumer efforts; how they dilute and counter any adverse scientific findings; and how they lobby governments and regulators.

I have taken an active interest in exposing these activities now for a number of years, and have also been actively following (and writing about) the potential long-term adverse health effects of cellphones since 1992.

To get just a brief idea of the scale of the research that has been done—and the sheer number of research reports that either show, or indicate that adverse health effects are possible from cellphones, I urge you all to look at the US government's NASA (Commission K) web site which has a partial listing (Before 1992) of research into potential adverse effects (and some positive and therapeutic effects) of EMG.

It gives you an idea of the complexity of this research also, and you will begin to see why it is difficult often to get replication or confirmation of an important study. See:

<http://ndadsb.gsfc.nasa.gov/anon_dir/multidis/URSI/URSI_K/K_REF.TXT>

Note that almost none of this research was directed at cellphones, since they weren't considered much of a problem until 1993. However a very large number of the scientists listed here have found adverse effects since, and are active still in this field of research—and probably three-quarters would agree with the statement "that there are long-term potential health risks associated with cellphone use".

My site at <http://www.electric-words.com> has a listing of the more important studies done until 1994 (still very little on cellphones). Since then the research funding has been variable, and a lot of the findings aren't published, so I don't think anyone has been keeping score.

Actually, this is a very important job that needs to be done, and it should be one of this committee's recommendations. Someone needs to build up an accessible library of relevant research—even if only in abstract form.

SUMMARY

To over-simplify my view of a complicated issue I would state that:

Potential—but not proved: The potential for serious health issues to arise from long-term cellphone handset use is highly significant. In my view the evidence produced by the good research (and only some of it is "good") is now highly significant, and needs to be treated as very serious. However, in no way does it approach "certainty". The evidence that suggests radio transmissions of this kind have no effect is also substantial, but in no way does this constitute certainty of "safety". When so many variables are in play in such a complex area of research, it is almost certain that there will always be conflicting findings and numerous unexplained zero effects.

Handsets rather than towers: The possibility that low-level, but significant health issues can arise (mainly in children) through long-term, insidious, 24-hour exposures to low background levels of radio pollution from cellphone towers, TV transmitters, etc certainly exists, but at a lower level of significance. The evidence is vague and much less convincing than that associated with handset exposure levels. If adverse consequences of tower-exposures are ever established, I believe they will probably be of minor communal importance when compared to the high radiation levels experienced by handset users, and possibly of less significance to those of other environmental pollutants such as lead in petrol, nitrous oxides, particulate pollution, etc.

Crisis-mongering vs chronic long-term problems: Public fears about the relative dangers of handsets and towers are almost totally misdirected. They centre on towers and on young children's low-levels of general-body exposure as if this were a critical issue, whereas the real problem will most likely come from handset use by young adults, chronically exposed to localised high-levels of R/F through their lifetimes.

Susceptibility and genetic predisposition: The evidence points towards biological effects of a number of different kinds, but they generally tend to indicate that only a few people will be randomly or genetically susceptible (DNA breaks, tumour promotion rather than cause, etc). This means that the likely incidence of any adverse effects in the population will probably be low and difficult to identify with the cause—but with 300 million users worldwide, even a 1 per cent incidence means three million potential victims.

Cellphone industry has become the tobacco industry of the 1990s: I have no doubt whatsoever that the cellphone industry (often in collaboration with the regulators and some governments) have engaged in a massive cover-up of the potential that exists for these problems. The industry has also been totally cavalier in its attitude; it conducted no research into biological effects, and set standards based primarily on electrical interference to electronic circuits.

They have employed all the modern tactics of polluting business sectors—like those of the tobacco industry and the pesticide manufacturers. They have responded to questions of safety with:

- highly aggressive and co-ordinated public relations campaigns worldwide;
- well-funded political lobbying;
- the creation of fake "grassroots" organisations;
- innuendo, slander and defamation of certain scientists;
- threats of advertising revenue withdrawal for editors and publishers;
- junkets for journalists;
- scientific fraud and manipulation of results;
- blocking publication of scientific findings; and
- scientific funding used as bribes.

Simple problems are largely solved: Now we are dealing with extraordinarily complex scientific issues at a molecular biological level. I also believe that the complexity of the problem is beyond the understanding of most of the normal medical "experts" in this field (unfortunately, many of whom provide advice to governments on health issues). In fact the problems are usually so far beyond the "complexity horizon" of both the public and politicians, that it is easy for the cellphone industry to sow confusion, pretending that "experts disagree".

A lot of the work being done on electrical and magnetic influences on cell-membranes and DNA involves a move from basic Newtonian physics to quantum mechanics and interactions. Cell membranes, for instance, are sometimes only two molecules thick, and so a voltage differential of 0.1V (the norm) represents a voltage gradient of 100,000 Volts/cm, which is equal to a car spark-plug. This is a new form of electro-magnetic-mechanics, because these voltages block access to messenger chemicals and viruses, etc.

Most experts with bio-electromagnetic research backgrounds would agree that there is a potential cellphone-health problem—but they'd disagree about the nature of the problem. They each see it from their own side of the speciality—and this discipline has many sides.

This allows the industry to claim legitimately that there is a lack of consensus on many issues, and it also helps create the impression that any claim of the need for research is a form of crisis-mongering.

The media also project many anti-cellphone activists as if they are nothing more than self-serving NIMBY Luddites (which tower activists often are—but who'd want a tower in their back yard); that they exaggerate the claims of danger (which they often do) and therefore the issue can be safely ignored (which it can't be, and mustn't be). Very often the activists are their own worst enemy here: they overstate the case and distort the evidence as much as the industry does.

SUBMISSION

1. DUBIOUS ADVICE TO GOVERNMENTS

The scientific and medical advice often being given to governments about the safety of cellular phone handsets (as distinct from towers) is grossly distorted. A majority of the so-called "experts" advising government have no expertise of any significance in biological research and often have a confused and biased view about these matters. Once committed to a viewpoint, many of them will never change.

Unfortunately, nature abhors a vacuum, and in the absence of real evidence and expertise, the "advice vacuum" has been filled by people who don't often know the full extent of their own ignorance. Radiation scientists and those whose expertise is in radio systems, generally believe that non-ionising radiation, by definition, can't be dangerous—because it is impossible for it to effect biological tissues unless actual tissue-heating results.

This belief is still being taught in universities; however, it is demonstrably wrong. If this claim were true, it would be impossible for humans to see (non-ionising radiation called "light" causes chemical changes in the retina).

Most scientists in the field, even those still promoting the "Proven safe" industry line, will now agree that it is likely that many non-thermal effects exist. They will argue, however, that the harmful nature of these has not been proved. This "sea-change" in certainty, has only recently been widely accepted, but it is now accepted by virtually all bio-medical researchers. Unfortunately, it has not yet filtered through to radiation physicists and electrical engineers who often advise governments.

2. INDUSTRY AND REGULATORS IGNORED THE POTENTIAL FOR PROBLEMS, AND DID LITTLE OR NO RESEARCH

The Industry has done nothing of any significance to ensure that cellphones are safe. I have conducted two interviews over the years with early technologists in Europe who discovered (and reported to superiors) that time-division technologies they were developing for GSM were environmentally polluting. They were both told to ignore these problems, and keep to the job in hand—yet both technologists recognised that any device which disturbs nearby electronics to this degree (GSM is notorious) must also have some health implications needing study.

I also have a copy of a UK Radio Technology Laboratory project report (1989) and a short Department of Trade and Industry (DTI 1990) summary, which shows that the UK government and industry both knew about these interference problems 10 years ago (See Appendix A/1 and A/2)[30] and did nothing about it.

These were faxed to me from an unknown source in Phillips in Holland, and they show that the European cellphone organisations also knew there was a potential for GSM cellphones to cause serious interference problems (hearing aids was then the major issue).

At this time the GSM phone was then in its early design stages and preliminary research had established that they generated massive amounts of electrical interference which could disrupt bio-medical devices and essential electronic systems. It was also noted by the engineers that these devices probably had the potential to cause health problems.

According to a phone interview I had with a spokeswoman from the UK DTI, the European cellphone industry was well apprised of these facts via reports sent to ETSI, and they deliberately chose to ignore the evidence. See also the statement of Dr Mikitalo (Appendix A/3)[31].

I also interviewed two telecommunications researchers, one of whom worked in Germany with Siemens, and the other in the UK. Both tell the same story; that the radio-interference effects of the technology were well known, but deliberately hushed up.

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[30] Not printed.

[31] Not printed.

The American cellphone industry also chose to deny the facts, even after the evidence of cellphone interference with hearing aids and pacemakers had been demonstrated in Australia (initially in 1994) and then in the UK. Only in the last three years have the Americans officially accepted this as fact—even though thousands of medical device wearers have reported time-division (GSM and US IS–54) cellphones were causing substantial problems.

Appendix B[32] shows that the interference with pacemakers was widely known for many years, although only revealed in public when I wrote a story about this in early 1993 (following the fuss over hearing aids, which was another story that I broke around the world).

You will note that the letter in Appendix B/1[33] is from the major Australian manufacturer of pacemakers. They consistently lied to me in 1992 after I had received reports of pacemaker problems and they continued with this line for many years. Evidence now shows that they had major problems.

Appendix B/2[34] is a mid-1993 exchange of letters with Austel, the Australian regulator of cellphones at the time. They had consistently denied in public there was any problem with GSM and hearing aids or pacemakers—but were hypocritical enough to discuss the reality with me in confidence—not for attribution of any kind.

On this occasion, Grant Symons, the second-in-charge of the cellphone division was stupid enough to speak in public about the matter (to an audience of cellphone industry executives) at a time when I had my tape recorder running and wasn't bound by a confidentiality agreement—and so the information was on the record.

I then spoke about Austel's awareness of the problems at a conference in New Zealand, and Austel were greatly embarrassed. They tried to pretend that I had lied and stated in public that they had no such information.

If you take the trouble to read the exchange of letters, you can see what happened—and how industry regulators very often protect the interests of their industry rather than that of the public. It took them only 24 hours to back down when I offered to publish the tape transcripts in my newspaper column.

This type of regulator-protective action is not an exception in this area in my experience. Rex Christensen was actually a very good technocrat/bureaucrat, and generally he did a good job. However, he was obviously being leaned on from above, or by the cellphone industry, to deny they had any pacemaker problems.

3. EVIDENCE OF ADVERSE EFFECTS HAS BEEN DISTORTED, OVERRIDDEN AND IGNORED

The history of this research is replete with dozens of cases where important research findings have been:

- Covered up and not released by government instrumentalities (mainly defence establishments who did a lot of the early work on radar and microwaves)
- Delayed in release until public counter-measures can be put in place and promoted. See the Royal Adelaide Hospital case study (Appendix Z)[35].
- Distorted in the public expression of findings; very often the public reports are at odds with the scientific reports. This form of distortion is very common, and is done in various ways and for different reasons:
    (a) as part of the contractual obligations for research funding. The distortion is usually through PR (spin-doctor) management and the purchase of press-agency distribution of industry-favourable PR releases as if they were impartial news stories (especially Reuters) (see Appendix Z);
    (b) by the scientists themselves, presumably in order to maintain future funding for themselves—and also for their departments and universities (they are often subject to peer pressure and administrative direction). (Also Appendix Z);
    (c) by scientists themselves fearing the consequence of "going against the tide" of perceived scientific opinion—especially the fear of their work receiving "junk science" labels;
    (d) by the media itself, putting its own spin on stories for various reasons—including the need to support advertisers, and also because reporters want to appear "scientifically credible" by supporting the "perceived wisdom" of the conventional "experts". (See Appendix X)[36];
    (e) by governments and government authorities, for many various reasons, including supporting local industries, employment, etc. Also because the most wealthy industry sectors are also the major political donors and have the most lobbying power. (See pacemaker material in Appendix B/2);

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[32] Not printed.

[33] Not printed.

[34] Not printed.

[35] Not printed.

[36] Not printed.

(f) by government funded scientific bureaus and regulators whose members usually come out of the industry concerned, and who share a common culture.

3.3 *The question of exposure standards*

These standards are, in most countries, "voluntary" or "guidelines" set by committees comprising mostly engineers and industry representatives. In the past they were set on the basis of electromagnetic compatibility (EMC), which means not interfering with other nearby electronics.

When mass-production equipment is found to interfere seriously, as it was with GSM digital mobile phones, the cry then goes up to:

(a) raise the EMC standard so as not to inhibit the sale of the equipment.

(b) force newer and higher levels of immunity (EMI) on the other equipment (such as hearing aids and pacemakers) by redesigning them and shielding them from the interference.

In other words, when the smoke-stack pollutes, they raise the level of quality needed by gas masks. This is why the world is now called by EMF environmental activists "The Blue World" and radio pollution is called "Blue Smog". We now all live in an unavoidable soup of electro-magnetic radiation—and it is extremely hard to now determine what is "normal" and what is not.

This is one reason why epidemiology finds it increasingly difficult to produce reliable results. The ELF and R/F effects may appear to cause low-level incidences of diseases like brain cancer, Altzheimers, and childhood leukemia—but if these effects only occur in those people more susceptible than others, and if the whole society is bathed in this form of pollution—it is an almost impossible task to identify any cause-effect relationship.

Standards setting, therefore, doesn't rest on any real science. See Appendix C/1[37] for an admission of this fact by the US Environmental Protection Agency.

What has happened around the world is that the various "standards bodies" have added to their "non-interference" EMC standards for electrical equipment, a claim that such standards are adequate to protect the human body from harm "unless the temperature of local tissue rises 1 degree Celsius". This is based on body-temperature rises in rats which clearly show the animal is distressed.

Later, when scientists began to discover biological actions and potential health effects at exposure levels far below any which might cause body tissue temperature rises, most of the standards bodies have had to take these "non-thermal" effects into account.

They have generally done this simply by adding a statement that "In setting these standards we have taken 'non-thermal' evidence into account" while not actually changing any of the standards.

In this current phase of standards setting around the world, attempts are being made to "harmonise" all national standards, to bring them in line with each other, so that the manufacturers can confidently export to a global market.

In Australia and New Zealand a co-ordinated standards committee was formed in 1991—headed by Dr Michael Repacholi. Prior to the combined committee, the New Zealand standards committee had voted to reduce their emission standards.

The aim of some of the NZ members was to move to the "precautionary principle" which suggests keeping cellphone and other similar causes of radio pollution as low in emissions as possible ("ALARA—As Low As Reasonably Attainable) and warning people to restrict usage or keep the instruments away from the head.

However, at the first combined meeting, the Australian industry representatives and Dr Repacholi ignored the New Zealand vote, and instead voted to raise one section of the Australian standards, with the aim of bringing it into line with the international ICNRP standard. (Dr Repacholi was the chairman of this committee also).

Consequently Dr Neil Pearce felt compelled to resign in protest. (Appendix C/2)[38]. Since that time the Australian/NZ committee has been in constant turmoil, dividing into two factions, with industry and government on one side, and the consumer representatives and biomedical researchers on the other. The industry objects to "precautionary principles" being added to the standards because they say it may open them to later litigation and additional costs in advising people that cellphones may be a health hazard.

The consumer/biomedical group has said it will accept the ICNRP standard as an interim measure, in the absence of anything better, but only if it is accompanied by a definite statement that this has been set on a "thermal" basis, and does not take into account "non-thermal" research findings—and should therefore not be treated as a level of proven safety, but simply as a guide.

This requirement has proven to be unacceptable to the industry and government representatives, and so they have spat-the-dummy and refused to ratify the ICNRP standards with this additional clause. Currently Australia has no valid standard for radio emissions of this kind. (The old ones had a sunset-clause, precisely for this reason, to ensure that they were reviewed in the light of new knowledge).

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[37] Not printed.

[38] Not printed.

Appendix C/3[39] is just a letter from the lecturers and professors at the Department of Physics, Monash University (top uni in Melbourne, Victoria) strongly opposing any attempt to raise levels. I include it just because it is extremely unusual for physicists to be worried about such things.

3.4 *Industry spin-doctoring and distortions of the truth*

Appendix D is a collection of documents put out by the cellphone industry. They have a world-wide distribution system for fire-fighting the occasional adverse health effect finding, and they are often not shrewd enough to post-date their distributed material so as not to provide evidence of prior knowledge. This Adelaide Hospital R/F report was supposedly kept secret—but the CTIA had a preview copy.

In fact the CTIA publication (Appendix D/1)[40] "Australian Tumour Promotion Study" was in circulation around the world before the release of any information in Australia. The official release of information occurred at a press conference in Adelaide on the morning of Tuesday 29 April 1997. This would still be 28 April in the USA, and the release is dated 27 April (Note: a Sunday).

This document was, in fact, circulating in Australia earlier than this— probably on the Friday. It provided the first information that many of us had about what was found by the Royal Adelaide Hospital R/F research.

Appendix D/2[41] is just a collection of propaganda, mainly material which is distributed around the world by the CTIA in Washington, and republished in Australia by the AMTA.

The first page lists the key animal studies that the industry constantly claims proves that cellphones are safe. The local head of the AMTA waved this document in a very recent TV interview with the local Nine Network's reporter Paul Ransley, and at the top of the list was research by Dr Ross Adey—one of the oldest and most respected of researchers.

I wrote to Adey asking why the industry was able to use just this one of his numerous research reports to make claims of safety on a television program, and this is his reply to Ramsey (available for public distribution):

Date: Thursday 22 April 1999 13:52:12-0700
To: pransley@http:
From: Ross Adey <RossAdey@citrus.ucr.edu>
Cc: fist@ozemail.com.au

Mr Paul Ransley
National Nine Networks, "Business Sunday"
Sydney, Australia

Dear Mr Ransley:

It has come to my notice that the Australian cellphone industry has singled out one of our studies to support their claim that cellphones are safe.

Nothing could be farther from the truth. My research team has published hundreds of papers on his subject over the past 35 years, many with disturbing findings.

From this pioneering research, it is my considered view that there is unequivocal laboratory and epidemiological evidence pointing to potentially adverse health effects of radiofrequency and microwave radiation. Nothing in our research findings can be construed as supporting the view that use of a cellphone is free from health risks.

To the contrary, our research in animal models exposed to digital cellphone fields has revealed the occurrence of effects on regulation of cell growth related to tumour formation. Extreme caution is necessary before directly extrapolating these findings to human health risks. Reduced tumour numbers in exposed animals seen in one of our experiments, as opposed to an increase, is of vastly less significance in a medical context than the finding that there was a field effect on cell growth regulation. It will be some months before these findings finally appear in an international peer-reviewed journal.

But with a feckless irresponsibility so characteristic of their venal vested interests, industry organizations have hastily concluded that our findings support their endless chant, indeed their mantra, that use of these phones carries no risk. And from the biomedical research of which they have been virtually the sole sponsors worldwide, they openly state that the only answer that they wish to hear is one unequivocally supporting corporate positions and policies, totally unfettered by health concerns.

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[39] Not printed.

[40] Not printed.

[41] Not printed.

Please be advised that these issues are currently the subject of close scrutiny from an international perspective by the BBC Panorama group for a programme to air in mid-May.

Thank you for your consideration.

W Ross Adey, MD
Professor of Biochemistry
University of California at Riverside
Distinguished Professor of Physiology
Loma Linda University School of Medicine
Fellow, Institute of Electrical and Electronics Engineers

The other studies credited here with proving safety are also interesting. The one numbered No 2 by Prof B Veyret of the University de Bordeau, I haven't read, but Veyret's 1991 paper "Antibody responses of mice exposed to low-power microwaves under combined, pulse and amplitude modulation," Bioelectromagnetics 12: P 47–56." is generally listed as one of the key studies that prove cellphones are likely to be dangerous.

Similarly the third on this list is one of Dr Salford's 1993 papers where he found no evidence of brain tumour promotion, but his published paper was a landmark study, not on brain tumours but on brain permeability: "Permeability of the blood brain barrier induced by 915 MHz electromagnetic radiation; continuous wave and modulated at 8, 16, 50 and 200 Hz. Bioelectrochem Bioenerg 1993;30:293–301."

This is one of a number in recent years which shows that the protective mechanisms of the brain can be breached by cellphone type radiation exposure. Salford and Lin are the two recognised experts in this area, and they both worry about the long-term effects of such biological actions.

Blood-brain barriers are important to block unwanted cells from invading brain tissue.

At the 1997 Bologna conference Salford presented another paper "Blood brain barrier permeability in rats exposed to electromagnetic fields from a GSM wireless communication transmitter," which is considered yet another landmark animal study in proving potential dangers—because this deals specifically with GSM cellphones.

The second document (a widely distributed press release) Appendix D/2, is another excellent example of industry distortion in its claims of "proven safety". It is blatantly labelled "Further evidence that mobile phones are safe". It supposedly reports on the Bologna conference in June 1997 where the vast majority of reports were discussing the mechanisms by which R/F effects cells, and other evidence pointing to problems.

Report No. 1. I have no knowledge of this, but I would comment that I've never heard any suspicion that rat livers are likely to develop cancer from cellphones. So these researchers could equally as well examined whether the rats developed a cancer of the tail, or nose, or whatever, and written a zero paper on that. You can always produce zero results, if you misunderstand the nature of the problem or design research to fail.

Report No. 2. I've dealt with this at length elsewhere. It was a total PR fiction. The release of the Finnish information was engineered by Nokia to counter the release of the Royal Adelaide Hospital finding of 2.4-times the number of lymphomas in exposed mice.

Briefly, the Finnish EEG study showed nothing of interest whatsoever, and is now completely and justifiably ignored (it took only a few hours to set up and complete with a few university students)—and the mouse study was then only in its early stages, and they had no autopsy results. See Appendix F[42]—letters from the two scientists who got caught up in this fiasco).

Report No. 3. Is the Ross Adey study mentioned above. It was just one of about a hundred that Adey had done on cell mechanisms, where he was trying to find out what frequencies had the greatest and least effect on the expression of certain hormones and cell repair mechanisms. He found that some frequencies enhanced the ability of the cells to block proliferation—while other frequencies worked the other way (this is called a "window" effect). The CTIA and AMTA just chose the one that showed a reduction in tumour promotion—but, of course, if cellphones can't affect human tissue then it should have shown NO effect!

Report No. 4. This refers to the Roti Roti study which, after receiving $US 5.4 million from Motorola, failed to replicate the Lai-Singh study. Note the use of the term "similar" to: (they used a quite different assay technique which was known not to give the same results).

Unfortunately for the industry, while it was loudly celebrating this "proof that Lai-Singh was wrong about radio signals causing DNA breaks", Roti-Roti joined in the publication of another study which seems to demonstrate cancer-promotion effects, which almost certainly came from DNA strand breaks—just as Lai-Singh had demonstrated.

Report No. 5. This refers to some study that found no "chronobiological" changes. Translated that just means effects-over-time!

There are about a dozen well-recognised studies that show melatonin modification effects after cellphone exposures; in fact, this is one of the few hormonal changes which seems to be accepted by everyone. This study seems to have tested some subject for levels of a hormone after "GSM telephone use"—which could mean anything. I couldn't find any reference to it in the published literature, but I don't have the full Bologna transcripts.

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[42] Not printed.

Note also the claim (point 6) that there have been "40 years of substantiated *(sic)* scientific findings that the RF energy from mobile phones pose no health risk" when cellphones have been around for less than 17 years and widely used for only about eight years. GSM phones, where most of the suspicion lies, have only been around for eight years—and most forms of adult cancer take a minimum of 10 years to develop, and problems like Altzheimers take even longer.

I guess the term "substantiated" implies "replicated"—but since they can't even quote one research report that proves safety, it is difficult to see how it can be replicated. You can't ever prove "safety" here—at best, you can only show a zero outcome—and that depends on what you expected to find.

The next industry advisory page in Appendix D deals with the Mild study into headaches from mobile phone use. This was actually a replication of a study done in Australia by Dr Bruce Hocking, ex-Chief Medical Officer of Telstra. He also found unexplained high levels of headaches reported by some GSM cellphone users while he was employed by Telstra, and later after he was "made redundant" (and compensated handsomely, on condition he did not report on his research at Telstra) he conducted another study and published the same results. Mild was trying to find out whether these widely-reported headaches were related only to GSM or also to NMT analog phones (used only in Scandinavia).

The AMTA advisory then builds up a straw-man, to knock down. It says: "In fact, nothing in the survey suggests that wireless users have a greater incidence of headaches than the general population." Later it explains why: "There was no non-mobile phone control group".

Why would there be: Mild was comparing analog to digital phone users.

The last page in Appendix D/2 illustrates how they deal with the public and politicians. The last paragraph makes the claim that "The Australian Standard is one of the most stringent in the Western World". In fact it is slightly less stringent than most other countries who have standards, and considerably less stringent than many.

Remember this claim when you read the section dealing with Australian standards.

Appendix D/3[43] is just a note which shows that research funded by the CTIA's WTR operation (Professor Om Gandhi at University of Utah) which was widely trumpeted around the world as proving cellphones to be safe (when it didn't anyway) was later found to be faulty. He corrected it.

Gandhi's most recent paper (1999) showed that many cellphones exceed the 1.6 W/kg per gm tissue SAR limit that has long been claimed as the upper-limit for healthy standards. This has been kept fairly quiet so far, but it is hard to see how the industry is going to continue their claim that their phones are within the IEEE exposure guidelines when the Gandhi measurement shows that they are being exceeded regularly.

Professor Gandhi was co-chairman of the IEEE committee (the industry body) which developed the 1991 exposure standard still in use.

3.5 *Over-promotion of the "scientific" line—the need for replication*

One favourite ploy of scientists, administrators and regulators when they want to play down a disturbing scientific finding, is to announce that it is only an "isolated example", and can therefore safely be ignored.

The fact is that every research report is "an isolated example" unless it is a direct replication of some work done previously. Given the fact that there are supposedly (according to industry sources) "20,000 research reports which prove cellphones to be safe" then it would be perfectly obvious to the village idiot that one proving otherwise is an "isolated example".

However, this labelling is used indiscriminately in cellphone research—and almost only ever when adverse findings are made. No one in the establishment ever comments or complains that any of these 20,000 reports are "isolated examples".

On the side of the evidence that shows disturbing health implications there must be at least 600 to 1,000 of these "isolated examples" which collectively support each other and paint a very disturbing picture.

Mouse studies

Another ploy is to loudly proclaim that this research was conducted only on mice, and that it is not possible to relate such evidence to potential human health problems—which must come as a surprise to the thousands of medical researchers around the world who conduct mice studies every day.

Mice are used because humans aren't always available to be exposed, killed and dissected.

Mice also have a life-span of only two years, and their metabolism takes them through the cell-lifetime stages of a human in roughly this time.

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[43] Not printed.

Mice studies have been shown to be very relevant to humans—especially when dealing with cells at the molecular level where DNA is DNA—and it appears to act and be effected almost exactly the same way in mice and humans.

Transgenic mice

These are used because the scientists want animals which are more sensitive to changes in environmental conditions, within the normal 18 month span of experiments. The results are always taken from the ratio of controls to exposed animals—and it is this ratio which is important, not any absolute numbers.

There's a full explanation of this at my site <http://www.electric-words.com> if anyone is really interested.

Replication

The main problems with replication of adverse research findings are these:

(a) These days most research is funded by the cellphone industry either directly (pretty well limited to Motorola in the USA, and Nokia in Finland), or indirectly through organisations like Wireless Technology Research (WTR) which sees its job as much as public-relations and industry-lobbyist, as it does funding and controlling legitimate research. WTR has the reputation of conducting some genuine, and some "tobacco science"—and certainly of slanting its funding choices to individuals and organisations likely to turn up zero findings.

(b) Industry sources are not likely to fund replications of independent research which shows adverse findings—like the various studies by Sakar, Lai-Singh, and Versheave which all found DNA breaks after brief exposure, or those of Adey and Philips who found much the same. (These are all labelled "isolated examples" incidentally!)

(c) For-profit research organisations are unlikely to get funding for such research from anyone—unless the work is covered by a contract which specifies that the results can't be published without the funder's permission. We know that some replication work has been done this way, but it is hard to prove. No one will talk about this.

(d) Independent universities in the USA will also conduct research under contracts which allow the funders to block the publication of results. Motorola, for instance, now only funds research in US organisations which will allow these contracts.

(e) Government funded universities and research institutions in the USA, and in most other countries, must not sign contracts which can block publication. They therefore get virtually no cellphone funding now in the USA.

These universities do have their own funding, but inevitably these funds are directed towards original research—stuff that will enhance the reputation of the university and its scientists. Replication has none of these advantages.

As a consequence, virtually no one replicates important studies in these important areas—yet the mantra is constantly chanted, *ad nauseum,* that adverse studies should be ignored until replicated.

There are some cases of replication (or near replication) which are either dismissed or discounted. For instance:

1. Professor Steven Cleary of Virginia Commonwealth University, USA, in 1990 published a paper on human glioma cells (brain tumour cells in culture) which showed that such microwave radiation could enhance the proliferation of human brain tumour cells. ("Effects of RF power absorption in mammalian cells").

He found a proliferation of the glioma cells after a two hour exposure to 2.45GHz (microwave) at 5W/kg (moderately-high dose for human tissue). His findings were consistent with the early changes seen in cells involved in tumour formation.

The disturbing finding here was that while the cell cultures were exposed for only two hours, the effects were being detected up to five days later. This means that each subsequent daily dose of radio exposure would reinforce the last—and the effects would be cumulative. He also changed the dosage in a parallel study, and reported a dose-related response.

Dr Ewa Czerska of the US Food and Drug Administration (FDA) also found similar changes in brain tumour cells. She reported these findings during a workshop in Washington, DC in February 1997. Czerska used 827 MHz radiation signals designed to mimic the emissions from a digital cellular phone (Cleary used a higher frequency) and she announced that she had at least partial confirmed Cleary's results—observing greater proliferation at specific absorption rates of 1.6 W/Kg and 4.8 W/Kg. "The increase also appeared to be dose-dependent", she said.

Czerska noted that this could not have been due solely to a thermal response, since conventional heating did not stimulate a similar level of proliferation. But this work was never published. It is widely reported in scientific circles that she was warned off the subject by both the FDA and Motorola, and given a desk job.

2. The surprise of the Repacholi Adelaide Hospital R/F study was the reporting of B-cell (basal cell) lymphomas involvement, when only T-cell (thymus) were expected. Basal cell lymphomas are closely related to cancer formation.

While this study hasn't been replicated, Uckan, Kurosaki, Jin, *et al* (at University of Minnesota–1995) have also found "that exposure of B-lineage lymphoid cells to low energy EMF stimulates" [special proteins] and possibly upset the "delicate growth regulatory balance" in cells. B-Lymphoma cells are known to be more sensitive to radiation exposures than T-Cells, and B-Cells are produced into myeloid tissue within the bone of the cranium. This gives this form of Lymphoma special significance for cellphone research.

3. The famous series of Lai-Singh studies showing single and double-strand breaks have supposedly failed the replication test. Professor J Roti-Roti received $US5.4 million (probably the most money ever given as a grant in this line of research) from Motorola to set up a special "comet assay" laboratory (this is an extraordinarily complex technique of detecting DNA strand breaks).

He failed to replicate the Lai-Singh work, partly because he used a different form of comet assay after being told that it would not work by Dr Narendra Singh, who is certainly the world expert on these techniques.

Similar research has produced almost identical results to Lai-Singh; and some of the cell-culture research also produces virtually identical increases in the DNA strand breaks with low levels of cellphone-type R/F exposure. Philips, J and Adey, R have both done cell-culture work that produces DNA strand breaks of this kind, and Sakar and Vercheave have both done live-animal exposures like Lai-Singh, and also shown DNA destruction.

What's more, Professor Roti-Roti has subsequently put his name to some similar research (See the March 1999 issue (page 300) of Radiation Research) which has reporting cell phone RF-signals caused a two-fold activation of the c-fos gene in fibroblasts. (The study was supported by Motorola).

This c-fos is a proto-oncogene which could be related to cancer development. On the other hand, DNA strand breaks are known to activate this gene. So it is very likely that they observed a DNA damage-induced activation of c-fos gene, which provides a link between DNA damage reported by Sarkar, Phillips, Verscheave and Lai-Singh, and cancer promotion reported by Repacholi, Guy and others.

In conclusion

While replication is important (and should obviously be done if any part of the cellphone industry will ever fund it), very often parallel findings make such replication largely irrelevant because essentially the same or supporting findings come from different techniques.

The industry, however, continues to chant "Not Replicated" to discount even the strongest of adverse findings—in a way that suggest daleks are on the loose ("Exterminate . . . Exterminate").

4. CASE STUDIES

I've included some simple case studies and explanatory notes showing how the evidence has been presented and distorted, and the way the media is manipulated in particular.

4.1 *Appendix Z–Royal Adelaide Hospital research*

The Royal Adelaide Hospital in South Australia (which has a top-class animal house for research), conducted two parallel studies on EMF exposure between 1993 and 1995. The research design was checked by a committee of the National Health and Medical Research Council (NHMRC) of Australia (the supreme medical research authority) and the hospital had a special committee supposedly oversighting the day to day activities.

The promoter of these two research projects, Dr Michael Repacholi (now in charge of WHO's EMF project in Geneva) sold the idea to the electricity supply organisation and cellphone industry as a way to solve their problems once and for all.

Repacholi is not so much a scientist (he has no research credentials before this), but is well-known as a spokesman and science administrator. He has long been one of the world's best known and most vocal "No Possible Effects" promoters for both low-frequency mains power and cellphones and therefore had the confidence of both the ESAA and Telstra.

The main research project was funded to the tune of $A1 million by the Electricity Supply Association of Australia (ESAA) to look at possible adverse health effects of mains-power exposure, and the second side of the project (run in parallel) was funded (probably $250,000) by Telstra (Australia's dominant carrier) to look specifically at possible effects of GSM digital cellphone exposures.

These studies were conducted in parallel during the 19 month period from August 1993 to Feb 1995.

The studies both had control groups of 100 animals, which were treated identically (down to the use of "sham" exposures), and both were double-blind trials where no one knew which autopsied mice had been exposed and which had not until after the diagnosis of cancer had been determined.

4.2 *The GSM R/F study:*

Six months into the formal phase of the study using GSM radio-frequency exposures of one-hour a day (probably in January and February 1994) the NHMRC's statistician Val Gebski noted a sudden and obvious rise in lymphomas in the exposed mice. Autopsies by Alan Harris at the Walter and Eliza Institute began to show an unexpected increase in B-cell lymphomas—and since this was unknown, and totally unexpected, the slides were sent off to a US research institution in Marylands for confirmation.

From this point on the scientists had no doubt that this was to be an important, and highly significant piece of research.

The exposed mice were showing:

- lymphomas at an earlier stage. The exposed mice had higher rates early (at about nine months), but the rate continued to rise throughout the 18 month study period;
- initially three to four times the lymphoma rate of the unexposed (later this rate dropped slightly to 2.4 times after some suspect ones were removed);
- the B-cell lymphomas linked to cancer, rather than the expected T-cell type found in the unexposed.

Note that this became evident to all researchers (including Michael Repacholi) in this early part of 1994.

The results for both studies were due to be published in March or April 1995 (See Appendix Z/2). However the GSM radio exposure study was released on 29 April 1997 after a never-satisfactorily-explained two-year delay. It took another year for the ESAA's electricity power study to be released.

The researchers claim that a year of the GSM-report time was occupied by checking the B-cell cancer question (they say the Marylands institute took a long while to do the work), and that another year was lost because the first three major publications (Nature, Science and one other) passed it for peer-review—but then decided not to publish "for political reasons" (the quote of one scientist) and because it was too hot to handle (according to one of the others).

Michael Repacholi also told me at the London conference in November 1996 that the study had passed peer review a couple of times, but hadn't been accepted for publication. This was the only bit of information that turned out to be true. Three publications rejected it before Radiation Research published the report—and according to one of my sources, only one of the publications had any significant comments about the quality of the paper, but they all rejected it on (admitted) "political" grounds as being too hot to handle.

Telstra maintains that it played no part in the official press conference at Adelaide on 29 April. However, Telstra was the major funder of the study and is also Australia's provider of video conferencing services. Telstra was known to have had the main results of the study at least a year beforehand, although this is denied by Dr Hugh Bradlow (See Appendix X/5). The Adelaide Hospital study scientists also claim that the confidentiality clause was insisted on by Telstra, not by the scientists (see Bradlow letter also).

It is important to realise that media control is a well developed art in Australia. Holding an important Australian medical/technical press conference in Adelaide is a bit like holding a similar, rather esoteric British press conference in Kiev—it's about the same distance from the media centres and the journalistic expertise. This ensured that the major press wouldn't be able to cover it. They will try to pick the key parts of the story up from Reuters, or perhaps send an Adelaide-based cadet journalist out to cover it. "The Australian" did neither.

Also, via a satellite video conference hook-up, Dr Michael Repacholi was brought into Australia from Geneva (he had headed off there to his new job with the WHO EMF Project before the study really got underway). Telstra maintains that the hospital paid for this extraordinary cost—but if so, it is the first time that any Australian hospital has ever had this sort of money to throw around (it would have cost $5,000 at least).

What's more, this claim that the hospital was paying for it allowed Telstra to block expert journalists like myself from participating in the video conference. Normally with a satellite link of this kind, Sydney and Melbourne technical journalists would have been invited to participate via Telstra's Sydney and Melbourne video conferencing rooms (they have a number, and one is always available).

I tried to get access to Telstra's facilities in Sydney, but was not permitted. In fact, although I write more about this subject than all other Australian journalists combined, I wasn't invited to Adelaide either, or advised by anyone officially that it was taking place!

The day before the 29 April announcement, Australia also celebrated the first anniversary of the infamous Port Arthur massacre in Tasmania where over 20 people died at the hands of a deranged gunman. This had triggered a nation-wide determination to recall and destroy all unnecessary weapons, which resulted in a fierce battle between pro-gun and anti-gun lobbies.

Consequently it was well-known beforehand that all Australian newspapers had plans to devote large sections of their news pages to multiple images of the formal ceremony (attended by political leaders and families of the victims) and discussion on gun control. Television coverage of the ceremonies and discussions on gun control filled all news and current affairs programs also. Radio had gun control on its mind, totally.

There would not have been a better day in the last few years in which to release a scientific story that the carriers and their spin-doctors wanted to cover up and keep quiet. This absolutely ensured that the official press-conference on April 29 was submerged in news coverage by the Port Arthur material.

After three years in almost total security, the story of the research finding was also leaked on the Sunday to the Hobart Mercury—in a way that has never been explained—meaning that "the scoop" was buried in a small provincial Tasmanian newspaper at a time of state and national mourning.

I had a contact in Adelaide who kept me informed, and I wrote the story for the national broadsheet, *The Australian*—thinking it could perhaps get front page coverage on the day after—but the news editor did not publish it at all, for reasons, she said, "of space", and later because she claimed it to be "old news" since it had been previously published in Hobart.

The story would not have got out to the wider world if I hadn't subsequently written full details in my columns on May 6 and May 15 (See both Appendix Z/3 and Z/4) explaining the significance, and I also circulated this material and some other notes to journalists around the world via e-mail and Internet forums.

The Adelaide Hospital study is now seen as probably the most significant research finding ever released which directly implicates radio frequency exposure as a potential cancer-promoter. It proves, almost beyond doubt, that radio exposures can have serious adverse effects on biological tissue—something long denied by the industry.

It does not link mice cancers to humans—but nor does any animal research. The importance also lies in the fact that findings were statistically highly significant (OR = 0.999) and the research controls and protocols were excellent. What's more, neither the scientists or the funders could remotely have been said to have wanted these results to emerge.

In my opinion, they did everything they could (legally) to stop them being heard or understood. See the Government's response in Appendix Z/1.

4.3 *ESAA mains-power study*

This side of the study used 625 mice overall, with 97 being "sentinel wild mice" (just to check for random diseases).

The 528 transgenic mice were divided into five groups (111, 105, 103, 105, 104) and the first became the unexposed control (actually "sham-exposed" or pretend-exposed) group. The others were exposed to constantly levels of 1, 100 and 1,000 microTeslas of magnetic field which was carefully filtered to remove the normal "transients"—leaving just pure 50Hz waves.

Why this was done has never been explained—although it is probably understandable if the ESAA had feared that random radio frequency transients may have been causing or promoting cancer. It created results which could not really then relate to normal human exposure.

One other 1,000 microTesla group received exposure on a 15 minute on, 15 minute off cycle.

What they actually found (I have the full study report) is a substantial rise in lymphoma in the most exposed groups above that expected (15 per cent was expected, but the highest found was 30.5 per cent). However they also found a very substantial rise in the rate in the control group (15 per cent expected, and 28.8 per cent found). This was further confused by an unexpected form of kidney disease which also hit the exposed group harder than the unexposed, and so made the interpretation of any clear-cut results virtually impossible.

These are the facts:

- There were substantially higher levels of lymphoma in the exposed mice;
- There were higher levels of lymphoma in the unexposed mice;
- However the difference between the two was not significant in statistical terms:
    - the highest exposed group had 32 cases or 30.5 per cent;
    - the second highest having 35 cases or 33.6 per cent;
    - the third highest having 27 cases or 26.2 per cent;
    - the fourth highest having 31 cases or 29.5 per cent;
    - the unexposed group having 32 cases or 28.8 per cent.
- The expected level of lymphomas in these mice (from historical records) was only 15 per cent—so even the unexposed mice were nearly double what had been expected. No one can explain this.

- There was also a high level of kidney disease with:
    - the highest exposed group having 20 cases or 19.2 per cent
    - the second highest having 16 cases or 15.2 per cent
    - the third highest having 12 cases of 11.6 per cent
    - the fourth highest having 9 cases or 8.5 per cent
    - the unexposed group having 10 cases or 9 per cent.

One would normally assume the significance of this is fairly substantial. There is a clear fall-off in incidence between exposed and unexposed—regularly progressing downwards as exposure is reduced. In fact the report admits this is statistically significant.

However this was outside the parameters of the research design (to look at cancer-rate incidence) and appears just to have been ignored.

One valid assumption here, could be that the EMF exposure was effecting the immune response in general, which explains the slightly higher lymphoma rate and the much higher kidney disease rate in the exposed animals. Such a proposition was never considered, apparently.

- In terms of surviving the full 18 months of the research program:
    - the highest exposed group had the least survivors—40 per cent
    - the second highest group had 42 per cent survive
    - the third highest had 50 per cent survive
    - the fourth highest had 46 per cent survive
    - the unexposed group had 45 per cent survive.

In other words, taken overall, less of the exposed mice survived—and the exposed mice clearly were more susceptible to kidney disease. The results therefore suggested that there could be health problems with high levels of 50Hz mains power. But fairly obviously these are not statistically significant findings taken overall, and you can't come to any conclusions without understanding what caused the kidney disease.

The only conclusion that anyone can make here with any certainty is that this research is worrying, and it certainly needs to be repeated urgently.

There is No Way this Research can be Considered as Proving that Mains Power Exposure is Safe

Especially since so many epidemiological studies also point to low level increased incidences of childhood leukaemia. (See other material.)

4.4 *How the release of information was handled in both cases*

Why Did They Take So Long?

The R/F cellphone study

The GSM cellphone study was published in the May 1997 edition of *Radiation Research* as "Lymphomas in Emu-Pim 1 Transgenic Mice Exposed to Pulsed 900 MHz Electromagnetic Field", by Michael H Repacholi, Antony Basten, Val Gebski, Denise Noonan, John Finnie and Alan W Harris. (See abstract Appendix Z/1.)

The claim is made that a two year delay resulted from:

- the need to confirm the finding of B-cell lymphomas
- the fact that three of the most prestigious peer-review publications refused to handle it because they didn't want to get involved in promoting this sort of controversy—despite the fact that the paper passed through peer-review with two publications easily and quickly.

I accept both of these arguments, having constantly experienced much the same resistance by editors to enter controversial fields, myself. My guess is that this explains half of the two-year delay, and a desire to let interest cool down explains the other year.

The ELF mains-power study

The second part of the Adelaide Hospital study was released nearly a year after the first (2 March 1998)—which was a full three years after the end of the mouse-exposure phase, and nearly three years after the analysis was first promised.

There is absolutely no excuse for this delay. The R/F study did present some problems, but not the ESAA according to the researchers themselves. They refuse to say why it took so long. But there were no B-cell implications that needed to be checked in Marylands—and the paper was published without the problems associated with the R/F study, so it could have been done in a few months.

This was clearly an attempt to let the publicity surrounding the R/F study blow over. No one wanted the claimed findings of safety to be examined too carefully. In July to December 1997 also, there was a very strong and very vocal reaction to the *New England Journal of Medicine's* Editorial (July 1997—See Appendix E/2)[44] calling for all funding of mains-power research to be curtailed. The UK *New Scientist* magazine also took this line in a story and an editorial. (See Appendix E/5.)[45]

This was followed, for many months after, by a spate of scientific letters and reports to editors of trade and scientific magazines pointing out that the "definitive" research (the NCI—Linet study) on which the *Journal* and *New Scientist* had based their claims, was incorrectly interpreted. However, I don't recall anyone ever printing a retraction.

In fact the NCI-Linet study confirmed numerous previous studies that showed a slight link between high mains-power exposure and childhood leukaemia. It is now used by everyone as one of the more definitive studies linking mains-power to ALL in children. (There are about 10 others with similar findings—mainly US and Swedish) and a few which are inconclusive.

How Did They Release the Information to the Public?

Cellphone

Through leaking it to a provincial newspaper in a day when Australia's interests were elsewhere, then holding the press conference in a remote part of the country and refusing to use a video-conference link already set up and paid for.

Mains Power

A Sydney press conference with all the trappings; press releases issued under the University of Sydney banner; one-to-one interviews for television news.

What Did the Scientists Say They Found?

Cellphones

The theme of the press conference was to play down the significance and emphasise that this only applied to mice—not humans. The principal scientists who had done the work were not made available and they stopped questions very quickly after the key announcement and speech from Geneva by Repacholi.

The discussion section of the report leads off with a typical weazle-word statement that "this single study" (suggesting that the evidence is unique and isolated, when it is not) "cannot be applied directly to assessment of human cancer risk." (Has any animal research ever been directly applicable to human risk?)

This paragraph and the study itself is most notable for its complete lack of discussion about the meaning and implications of the positive effects—and for presenting as many reasons as they can think of for discounting the finding—and for suggesting that this could somehow be viewed as a trial on the usefulness of transgenic mice in radiation studies.

The Fact is That it Established Clearly and with Little Room for Doubt that the Industry Claim that "Cellphone Radiation Cannot Possibly Affect Biological Tissue at Non-Thermal Exposure Levels," is a Complete Lie

And this finding is only one of hundreds which have consistently shown this, with varying degrees of validity and credibility over many years. It fits almost perfectly into the overall "assemblage" of evidence accumulated by many different independent biomedical researchers from many varied studies on animals and cell-cultures.

Mains Power

The findings were finally made public at a Sydney press conference, complete with press releases from Sydney University's Centenary Institute headed "No Evidence for Cancer Link with Powerlines". The report was published also in *Radiation Research* journal.

Professor Basten sought out the ABC and commercial television stations and did one-to-one interviews with each, where he was quite adamant that this research now proved almost beyond doubt that power-lines did not cause cancer. I recorded three TV news programs that night, and each led with this statement, and each later included a Basten interview stating that power-lines now had the all clear.

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[44] Not printed.

[45] Not printed.

The ESAA also issued a press release headed "Australian study reveals no evidence for EMF cancer link" which says:

> "The result is reassuring because the mice used in the study were particularly sensitive to showing subtle changes of any magnetic field effects [A total distortion—there is no known link between magnetic fields and lymphoma] and the magnetic field levels used in the laboratory were much greater than those experienced by people in daily life." [Actually some of them were at about normal exposure levels, and some were higher.]

WHAT WAS ACTUALLY FOUND (AS SHOWN IN THE REPORTS)?

Cellphones

- Highly significant increases in lymphoma in the exposed group compared to the unexposed.
- A different type of lymphoma in the exposed.
- A much more dangerous type of lymphoma in the exposed.
- Earlier onset of lymphoma in the exposed.

Mains Power

The result is confused by the kidney disease, and no real conclusions can be drawn. However, there were noted increases in both lymphoma (very small) and kidney disease (highly significant) in the exposed groups, and this needs urgent research to clarify.

WHAT CONCLUSIONS CAN BE DRAWN?

Cellphones

The claim that it is not possible for radio signals to affect biological tissue is resoundingly defeated. The indications are that cellphone type and level of radiation can act as a cancer promoter—and this needs urgent further work, and justifies the call for the application of the prudence principles.

Mains power

More and urgent research needs to be done (NO ONE IS DOING IT). This study has proved nothing—but suggests that compromise of the immune system might be the mechanism.

4.5 *Manipulation of the media*

What interests me here is the way in which the release of the information was manipulated—by the scientists, by the hospital, and by the ESAA and Telstra (it is often not clear which)—and sometimes by all of them together.

Remember, two and a half years after the completion of the study, not one word of results had leaked out. In the interim, Dr Repacholi had attended dozens of conferences and given dozens of interviews, and still vocally maintained his stance that there was no evidence connecting cellphone exposures to adverse health consequences—knowing all the time that his mice had shown a major, highly significant, increase in basal-cell lymphomas.

Yet Michael Repacholi told me off-the-record at a London Conference on 15 November 1997 (it is recorded in my journalist's notebook) that the research had turned up "nothing of any significance". He also revealed that the group had problems finding a publisher. I already knew this from another source in the research team. (See Appendix Z/12 e-mail from Repacholi also).

At the same London conference, he was very vocal in supporting industry claims that there were no studies linking cellphones to adverse health effects and strongly criticised a few scientists who had turned up positive results. There were dozens of people at the conference who can attest to this.

At this time Dr Repacholi was the head of WHO's EMF Project and probably the second most powerful cell-research-funding bureaucrat in the world (Dr George Carlo was the most powerful)—yet he was publicly denying and discounting his own unpublished research.

At that time Repacholi had known for over two years that the Adelaide Hospital research finding was the most significant link yet discovered. It had a "highly significant" p-value, and an Odds Ratio (OR) of 0.999—meaning that this doubling of leukemia in the exposed mice could only have arisen by chance once in a thousand experiments. This is 10 times more significant than the normal 1 per cent "high-significance" level in a very well-conducted live animal trial.

Even more significance lies on the difference between the exposed and unexposed groups—and in the fact that normal GSM cellphone handset exposure levels produced this cancer-promotion (not initiation) result with one hour of daily exposure over nine to 18 months.

So Repacholi's claim to me that the findings were "not significant", and also the fact that he continued to maintain at scientific conferences that there was no evidence that cellphones can be harmful, was not the truth. A number of scientists have also complained bitterly about this sort of conduct by Dr Repacholi, on this and other related matters—but this was my first and only experience.

How Was the Study Concluded?

A point not made elsewhere in the literature is that, at the conclusion of the 18 month period of the study, the remaining live mice were killed—BUT NOT AUTOPSIED.

Since the level of lymphomas in the cellphone study had been rising steadily from six to 18 months, it would have been reasonable to assume that even more significant figures would have been found if the last live animals had been autopsied. This was not done—and I find this fact very disturbing.

How Did the Science Magazines Handle the Cellphone Story?

I couldn't get any of the electronics magazines interested, or the science magazines I sometimes write for, so finally I wrote a few columns (See Appendix Z) and followed up a year later with a couple showing how the industry was manipulating both the cellphone health issue and the electricity mains-power results (also included here).

I also wrote and circulated a couple of long pieces on the cellphone research to other journalists via the Internet. *New Scientist* then approached me to write 750 words on the subject.

This is a very short story for such a complex subject. They then rejected it and asked me to write a longer explanatory piece—which I did—and which they then cut to about 500 words, dumping all the explanatory material, and filling the page with public-relations rubbish from the US Cellular Telecommunications Industry Association saying why the study wasn't of much importance (See Appendix Z/10).

They published this under my name after very strong objections from me—and then refused to publish a letter where I disowned the second part of the story as it appeared. I now refuse to write for this publication, or their sister publication *Electronics Weekly.*

5. The Industry Reaction—the Finnish Studies

A few weeks after the news of the Adelaide Hospital research spread around the world, Nokia and the European manufacturers mounted a tactical response. They dragged out two studies that they had funded to prove that cellphones were safe.

They hurriedly put together a Helsinki press-conference (May 22 1997), based on the work of Maila Heitanen (completely unknown in the R/F research field), who had subjected 19 University students to an electro-encephalogram and switched a GSM phone on in the room, while watching the brain waves.

She concluded that there was no change in the brain waves.

To build up some credibility, they also had a progress-report by Jukka Juutilainen (a highly respected researcher in this field) who was part-way through a mouse study (which appears never to have been published).

They then had Reuters issue a press release which went around the world, and was widely quoted as:

MOBILES SAFE, STUDY FINDS, BUT THEY DO HEAT BRAIN
or
FINNISH STUDY FINDS NO HEALTH HAZARDS IN MOBILES

An amazing number of newspapers and magazines around the world carried this as a lead story, because if followed the "scare story" of the Adelaide mice by only a few weeks—and it kept advertisers happy—and it arrived as part of Reuter's regular news feed.

The full details are in Appendix F, including my e-mail correspondence with the two scientists, asking how they got caught up in this sham.

You will find this most instructive.

It is not unusual. In fact, I would say this sort of "good-news" publication is the dominant form of cellphone-and-health news circulated by the major press agencies.

See how they handled the UK Preece study.

6. THE CTIA, WTR, DR GEORGE CARLO AND THE US RESEARCH EFFORT

The research effort supposedly mounted by the Cellular Telephone Industry Association (CTIA) in the USA is pretty much a sham from start to finish. More money has been spent on junkets, conferences for scientists who are willing to play along and on research intended to find nothing, than on legitimate research.

I think there has only been a couple of legitimate research fundings although $27 million has supposedly been spent in the last few years.

The CTIA chose Dr Carlo to run the WTR, not because of his scientific research expertise—he has none—but because he is a well-known scientific "fire-fighter" who can organise sham science when industries are subject to attack.

His biography is up at my site lebelled "Dr George Carlo—This is your life." <http://electric-words.com/radiation/carlo.html>

All the information here can easily be checked on-line.

My first experience of Carlo was when he arrived in Australia in 1990 as an "independent dioxin expert" hired to check Melbourne's water supply after a spill of the herbicide 245-T by a company called NuFarm.

His report abstract is in Appendix G/1.

He gave the water supply a clean bill of health, and this was accepted by authorities.

At that time I was involved in dioxin research. What we didn't know was that:

- Dr Carlo was a paid consultant in the USA to the Chorine Institute which lobbies on behalf of dioxin-producing companies.
- He was (or became) the technical director for drug companies Pharma and Pharma Pacific—which, like NuFarm—was a subsidiary of the New Zealand chemical company Fernz.
- Carlo has no biomedical qualifications. He is a statistician/epidemiologist with a law degree. He wouldn't know how to test for low levels of dioxin in a fit.
- His associate "scientists" on this paper (Sund and Baller) have even less qualifications than Carlo. One appears to be his secretary, and the other is a contract lawyer in Washington.

I only found out about this when I began to look into the background of the key scientist that the cellphone industry had decided would control the initial $1 million token research effort. Later the US Senate made them put up $25 million.

There is a lot of material here, which just serve to show that the US choice of "chief scientist" is a total sham. Carlo is a lobbyist and science-for-sale entrepeneur with a dozen different companies, and financial interests in drug companies pushing immunisation products, and he employs a large number of people doing research who have little or no experience, and often little or no qualifications.

As the WTR money is running out, he is now shifting his attention from cellphones to breast implants, and runs the "Breast Implant Public Health Project: A Public Health Alternative" for Dow Corning.

The material here (Appendix G)[46] and at my site will tell you more in 10 minutes of reading about this man, and the genuineness of the CTIA's research efforts, than anything I can write here today.

THIS IS IMPORTANT:

Firstly

It is important to separate the cellphone handset exposure problems from the tower problems and the so-called Blue-World or Blue-Smog fears.

Secondly

However, don't necessarily separate the radio-frequency (including microwave) problems from the powerline. There are pulses in cellphones which give them frequencies close to those of power-lines, and there are "transients" in power-lines which are almost identical to radio transmissions.

Thirdly

Recognise that this area of research involves a wide range of disciplines than almost any other—and this complicates the matter. It requires highly skilled, dedicated researchers who understand dosimetrics (how exposure measures can be compromised or incorrect) and who have a deep understanding of molecular cell biology. An enormous amount of expensive research is being done by people who only understand about 10 per cent of what they should know—I find this every second time I talk to someone doing this research. Their ignorance of some basics is often extraordinary—on both sides of the divide.

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[46] Not printed.

Fourthly

Be aware that there are strong prevailing prejudices and knowledge-fashions in some of these disciplines which makes them "certain" when they should be curious. Often their claims of "expertise" are dubious because they are so narrow and focused in their knowledge.

Here are some of the fashions of thinking:

(a) Ionising radiation physics and physiology

> These experts know, without the need for any further investigation, that it is impossible for non-ionising radiation to have sufficient energy in the photons to disrupt hydrogen co-valent bonds in biological materials and chemicals. Only X-rays and above can do that.

Therefore, in their view, it is not possible for R/F to create adverse health effects at levels below those which cause a temperature rise of at least 1 degree Celsius.

The only problem with this theory is that it is wrong, and is known to be wrong by anyone who has studied a range of bio-medical subjects. For instance, a dark-adapted eye can see a distant star when only one photon could possibly have triggered the chemical-based retinal cell response. This is non-ionising radiation triggering a series of chemical-based cell-responses at energy levels which can only be minute fractions of a per cent of the thermal threshold.

There are a couple of reasons why this is possible. Bonds don't necessarily need to be broken to have a biological effect. Often they flip in a left-versus-rights way; and stochastic resonance can use the inherent "noise" in biological systems to super-sensitise the cell actions.

(b) Radio engineers

These people look on the body as nothing more than a complex electrical circuit, and want to treat it as if it were some homogeneous electrical or magnetic mass—like a dipole antenna. They involve themselves in endless discussions about resonant frequencies of the head, and the coupling effect of the handset with head-tissues, and try to derive judgements of likely biological mechanisms from their understanding of copper + transistor electrical circuits. They see DNA as a crystal-set coil, and tissue layers as condenser plates.

They have been taught from early university days that radio frequencies can't harm people below the thermal limit, and since they rise to prominence through electronic engineering associations and cellphone companies and now occupy the key positions in each national standards committee, these views hold enormous sway in setting exposure standards.

Generally these standards were devised in order to prevent intentional or unintentional radio transmitters from interfering with other electronic circuits nearby. Health concerns were tacked on to these pre-defined standards for occupational reasons (mainly after war-time experience with radar and ship-transmitter inadvertent exposures), usually by the rather arbitrary inclusion of the 1 degree Celsius "thermal safety limit".

Later, when the possibility of non-thermal effects began to be discussed in the community, it was these people (now running the national and international standards committees) who have been charged with deciding what is a safe exposure level and what is not.

Quite apart from their obviously partisan position as company and industry representatives, they are of the old-time "practical engineering" school, who rather despise environmental and health activists—especially if they seem to have a lot of ridiculous fears (which they inevitably do).

THE PROBLEM IS THIS

Nothing has been "proved" in the scientific sense about the dangers of cellphones—and most of the public fears are misdirected at cellphone towers, whereas virtually all the scientists see the handsets as the problem.

They see this as a long-term potential problem rather than anything critical—and most believe that the problem could be alleviated by a bit of phone design to get the antenna away from the head (perhaps putting it at the other end, below the microphone).

There are now strong indications that there will be a significant health problem in 10 years or so. This, I feel is now reasonably well established, but it is difficult to say what form this might take. This is not apparently a problem that has one-to-one links, like asbestos and mesothelioma—or cigarettes and lung-cancer. The range of effects appears to be quite wide, probably involving growth, ageing and immune responses. This itself creates a problem.

As a society we are use to dealing with environmental-diseases where the effects have a strong link with one cause. Tobacco and lung-cancer, for instance, was recognised long before tobacco was linked to heart problems and breast-cancer, because these have alternate causal links. Asbestos only became widely recognised as a cause of cancer when it showed a near perfect link with mesothelioma (and no other cause for mesothelioma was known). Prior to that it had an indefinite link with smoking and lung-cancer.

When clear-cut one-to-one links like that between mesothelioma and asbestos are lacking, the disciplines of medical science and statistical analysis have a very difficult job in establishing cause-effects links.

The reason why it is becoming more difficult to establish links like these could well be that the easy work has already been done. Now medical science is being asked to deal with:

1. those which have shot-gun effects over a wide-range of health conditions (attacks on immune system, promotion rather than "cause" of cancers and those involving hormonal or cell-messenger responses).
2. those which create conditions indistinguishable from ageing (Alzheimers and Parkinsons; memory loss).
3. those which may appear to be psychologically based, rather than biologically (above, plus chronic fatigue, sleep problems, electro-sensitivity, tension and headaches, etc).
4. those which have a long-term, rather than any critical relationship between cellphone use and the health problems.
5. those which have an inverse exposure response (light exposure may cause DNA disruptions and mutations; heavy exposure may kill the cells):

(a) R/F might be varied in its effect.

Brain cancers and Alzheimers are the two most publicised likely effects, but the evidence is more that these are just the two associated with the exposed area of the body. Many scientists believe the effects are more broad-spectrum in nature, involving immune system responses, or blocking normal apoptosis (programmed cell-death) processes and leading to cancer and similar conditions. But there are also signs of neurological (perhaps psychological) conditions such as headaches, memory changes, etc. This is not likely to be a causal connection which has direct and clear-cut relationships.

(b) R/F is certainly insidious in effect.

There is not likely to be any critical or dramatic symptoms from most of the conditions. Therefore it is unlikely that any causal connection will be obvious to users—apart, perhaps, from headaches and so-called "electro-sensitivity" (if this proves to be real).

(c) R/F exposure effects are likely to be very long-term in nature.

No one expects cellphone users to be dropping dead in the streets while using a cellphone. The nature of the problem is much more likely to surface after 10 or 20 years of use.

(d) R/F effects are likely to be low-level in terms of incidence, but still a massive public health problem.

It is likely that these problems may only affect a few per cent of the user population. The unlucky ones could either be:

(i) genetically predisposed;

(ii) super-sensitive by reason of previous exposures to other cancer-causing agents;

(iii) high-users;

(iv) subject to cumulative effects associated with mains-power, and/or other radio emitters (VDUs, etc).

11 June 1999

APPENDIX 22

Memorandum submitted by The Carphone Warehouse

1. INTRODUCTION

The Carphone Warehouse is the UK's largest independent retailer of mobile phones and is committed to providing customers with impartial advice on every aspect of buying or using a mobile phone. To this end, in January 1998, it launched an information service to keep its customers abreast of all developments relating to mobile phones and health.

2. SUMMARY

The Carphone Warehouse publishes regular fact sheets entitled "Mobile Phones and Health", produced following consultation with a number of independent bodies and expert scientists including Doctor Alan Preece (Bristol University), The Federation of Electronics Industry (FEI) and The National Radiological Protection Board (NRPB). The fact sheets are designed to unravel what is a very complex issue. By presenting customers with the findings of scientific studies as they are published, together with the latest comments from medical and industry specialists, The Carphone Warehouse aims to equip its customers with the factual information needed to make an informed decision when choosing a mobile phone and accessories.

The fact sheets are available in all 180 stores nation wide, and include a telephone number for customers to register an interest and automatically receive all future editions. The information is updated on a regular basis as and when scientific research is released.

3. CONSIDERATIONS THE COMMITTEE WILL CONSIDER

3.1 *The quality and objectivity of the advice provided at present*

The Carphone Warehouse fact sheet is produced in consultation with a number of independent bodies, and each issue is carefully checked against scientific data and published information. We cannot comment on the quality and objectivity of advice available from other industry sources or retailers, although we make significant reference to the Federation of Electronics and the NRPB's literature, with reference to mobile phones and hearing aids.

3.2 *The suitability of current procedures and structures for obtaining good quality advice*

The Carphone Warehouse believes in providing customers with simple, impartial advice in every single aspect of buying or using a mobile phone. The fact sheets are only a "snapshot", however, and are not intended to be a complete evaluation of the issues involved. The Carphone Warehouse welcomes any activity which clarifies this whole issue for customers, including the case study produced by the Scientific Advisory System and Science and Technology Committee.

3.3 *The extent to which there are grounds for health concerns*

The Carphone Warehouse believes that no firm conclusions can be drawn based on the evidence available currently. However, it is committed to monitoring the situation, and to putting together updates on the latest tests and results, enabling customers to consider all the relevant issues in this area. In particular, the company welcomes the two major studies being conducted by The World Health Organisation, and the National Radiological Protection Board.

3.4 *The opportunities for new technologies to reduce health risks*

The Carphone Warehouse currently stocks a number of accessories, such as Hands Free sets, Ear-pieces and Shields. We cannot, however, comment on their effectiveness, as there has been no independent research which has been carried out on these products.

3.5 *The need for further research*

As there are no firm conclusions that can be drawn at present, The Carphone Warehouse welcomes any further research in this area, and is committed to monitoring the situation and to providing customers with regular updates.

21 June 1999

APPENDIX 23

Memorandum submitted by the Department of Trade and Industry

INTRODUCTION

1. The Department of Trade and Industry (the Department) is responsible for licensing the UK mobile network operators under the Telecommunications Act and has developed a competitive regulatory framework for the telecommunications industry. It also has sponsorship responsibilities for the mobile communications manufacturing industry and the mobile operators, and seeks to ensure that the UK maintains one of the most modern communications infrastructures in the world.

2. The Department also has responsibility for the safety of mobile phones sold as consumer products. These responsibilities are explained at paragraphs 23-24. The Health and Safety Executive has responsibility for the safety of mobile phones at work.

3. The Radiocommunications Agency is responsible for issues concerning spectrum management under the Wireless Telegraphy Act and does not participate directly in the discussion about mobile communications and health.

4. Separately, the Office of Science and Technology (OST) has a general role in ensuring that all Government Departments adopt and use certain principles and best practice in relation to the use of scientific advice. This role is described fully in the two memoranda already submitted to the Committee's inquiry by OST, in June 1998 and May 1999.

5. In view of its responsibilities for the mobile industry and the desire to see the UK as a world leader in mobile communications technology, the Department recognises the need for well founded scientific advice based on independent assessment of world wide research in mobile communications and health, in accordance with OST's guidelines on the use of scientific advice in policy making. In responding to questions about the alleged harmful effects of exposure to electromagnetic fields from mobile communications equipment, the Department (along with other Departments) calls on the expertise of the NRPB. Details of their statutory responsibility for provision of advice are provided in the NRPB submission. The NRPB is an internationally respected body in the area of non-ionising radiation protection. We advise the mobile communications industry that they should comply with the NRPB Guidelines for restricting human exposure to electromagnetic fields. Our understanding of actual measurement work undertaken is that mobile phones comply with the Guidelines, and we advise the public accordingly. The position with regard to base stations is discussed in paragraph 12 (below).

DTI scientific activity in mobile phones and health

6. In addition to the advice available from the NRPB, the Department has supported research in measurement of exposure to electromagnetic fields at radio frequency. It procures technical advice and funds physical measurement studies relevant to its responsibilities for the mobile industry, eg issues relating to network performance on occasion when information is required which falls outside NRPB's remit and to support the UK's capability in measurement research.

7. Officials of the Department participate in the wider scientific debate and are represented on COST 244 "Biomedical effects of Electromagnetic Fields". COST 244 is a European collaborative research project which funds workshops under the COST mechanism (COST stands for Co-operation on Science and Technology—an umbrella organisation part funded by the European Commission). Although COST 244 covers all frequencies, including power-line issues, signficant effort has been devoted to the mobile communications frequencies. Researchers involved in COST 244 represent significant research capability coming from all COST national participants. The Department has taken an interest in COST 244 because the NRPB did not have the resources to become involved.

8. The Department has not contributed directly to biological research, but welcomes initiatives such as that of the World Health Organisation Electromagnetic Field (EMF) project and the proposed European research programme under Framework V, because we wish to see good scientific work undertaken that will be subject to peer review and published in a proper scientific manner. The work proposed in these initiatives will, we hope, be systematic in its approach, will add to our existing knowledge, and can be properly considered in the appropriate national and international bodies which provide guidelines for restricting human exposure to electromagnetic fields. The Department has pushed for such work to be undertaken primarily through its participation in COST 244, which provides a forum for discussion of the requirement for further work.

Quality and Objectivity of the Advice Provided

9. The NRPB are responsible for provision of advice which is provided through their Advisory Group on Non-Ionising Radiation (AGNIR). The role of AGNIR is explained in the NRPB and Department of Health Memoranda. The advice provided by the NRPB is consistent with advice from other national and international bodies, eg World Health Organisation.

10. The Department recognises the need for an interdisciplinary approach to research such as that available from the NRPB. Research in the subject requires a mix of skills principally in biology but also in physics and engineering. The NRPB adopt an interdisciplinary approach and have conducted work in biology as well as computational measurement at mobile telecommunications frequencies. It is widely recognised that simplistic "research", particularly where the exposure conditions are ill defined, is unhelpful and unlikely to shed any light on the subject. When discussing further research needs the World Health Organisation EMF project states "It is essential for high quality research that accurate assessment of RF field exposure be an integral part of all future studies and that each research team include scientists skilled in RF dosimetry".

SUITABILITY OF CURRENT PROCEDURES AND STRUCTURES

11. Given the Department's wide responsibility in mobile communications technology, it is important for the Department that the highest quality advice is available. The UK, particularly through the NRPB, participates actively in international bodies such as ICNIRP (International Commission on Non-Ionising Radiation), IARC (International Agency for Research on Cancer) and WHO (World Health Organisation). The Department's own participation in international workshops and conferences confirms the UK has arrangements for provision of scientific advice comparable with other countries.

THE PROCESS FOR ASSESSING SCIENTIFIC ADVICE IN POLICY MAKING AND REGULATION

12. The NRPB Guidelines and advice provide the Department with a clear basis for policy making and regulation. Compliance with the Guidelines is not specified in any of the regulatory functions for which the Department is directly responsible. Compliance with the Guidelines is not a condition of a licence issued under the Telecommunications Act, but we recognise it is important that both hand sets and base stations comply and that measurement techniques are sufficiently rigorous. For base stations the NRPB and the Department make clear to the public that Guidelines can be exceeded in areas close to and directly in front of the antenna, within one to two metres, but that exposure at ground level and in areas to which the public have access are invariably many times below the recommended exposure levels. Exclusion zones are provided to prevent the public gaining access to areas in which the Guidelines can be exceeded.

THE EXTENT TO WHICH THERE ARE GROUNDS FOR HEALTH CONCERNS

13. It has been suggested that athermal effects are harmful. The view of the NRPB and other independent scientists is that it is not possible to develop guidelines for protection on alleged effects where no plausible biological mechanism can be demonstrated. Any such guidelines eg to lower the exposure limits would be arbitrary and would not be based on a scientific assessment of risk. It has also been suggested that a "precautionary" approach should be adopted in the light of current concern. Further elaboration of how the precautionary principle in its widest context can be applied is being developed. However, most sources or statements on this principle eg the Rio Declaration, suggest measures should be cost effective. There is also, usually, reference to an assessment of risk. If we assume that measures should be cost effective, in the Department's view the justification for a "precautionary" approach to alleged health effects of mobile communications would therefore not rest solely on the perception of a potential but currently unsubstantiated risk.

14. The present health concerns have been generated by adverse media interest in a small number of studies that show a suggested athermal effect. It is the view of the NRPB that these need to be seen in the context of a larger body of research that shows no effect. This view is endorsed by other international agencies including the WHO. This Department has no grounds to question this view. There is sufficient ambiguity in the corpus of scientific work to justify further research (see below), but not to conclude that there is a proven risk to human health.

OPPORTUNITY FOR NEW TECHNOLOGY TO REDUCE HEALTH RISK

15. In the absence of a clear biological mechanism it is not possible to scope new technology development specifically to ameliorate health risks. If one assumes that power levels are the main source of risk then lower emission devices and directional antennas could lead to lower exposure. The current commercial pressures on hand set development (particularly lower power consumption) will inevitably lead in this direction.

16. The introduction of digital GSM based mobile technology from the early 1990's has enabled an unprecedented expansion of the mobile market. GSM provides data rates of 9.6 kilobits per second. This provides for good quality speech, but provides only limited multimedia applications at low transmission rates. Planned future technical developments will provide for higher data rates enabling greater multimedia capability at data rates up to 2 megabits per second. The technology proposed is known as UMTS (or Universal Mobile Telephony System). UMTS technology is proposed for introduction by 2002. It is too early to ascertain if the introduction of UMTS will lead to lower exposure as the exposure will depend on a number of parameters that are yet to be agreed. The Department is funding research into measurement techniques for UMTS in order to provide futher advice in this area.

17. The main driving forces for hand set design in which longer battery life and lower power consumption are required has led to improved power control and antenna technology. New products based on these technologies are being introduced.

18. A new development in network architecture will be the introduction of microcells. Microcells and picocells are intended for urban locations and in building services. Introduction of microcells follows from splitting of the traditional cellular structure. The large cells are still needed to provide umbrella coverage. Microcells will be lower power and will be small but they will not give contiguous coverage. It was never intended that they would be used for rural areas.

19. Some have suggested antenna shields may provide protection as they claim to reduce exposure, but some studies suggest that they can interfere with the efficient operation of the hand set. Widespread use of such devices may also have implications for the proper use of a network since those studies suggest that they may impair base station efficiency. The implication of these studies is that additional base station infrastructure would be required.

Need for Further Research

20. The Department recognises public concerns and has sought to respond appropriately. The Department is actively seeking to find ways to explain to the public the basis for the present guidelines and the evidence for the suggested athermal effects. The Department has also supported the Department of Health initiative to establish an expert group to examine the current status of research in this area.

21. The Department has supported the principle of the need for further research for a number of years. The EU expert group report of 1996 provides a prioritised agenda for further research. This is being updated by a COST 244 activity funded by the European Commission DG XIII. It is widely agreed that further research should be international and should be collaborative. The Department continues to press for corresponding work of the highest quality to be undertaken.

22. As has been indicated, the Department continues to fund work in measurement and has a particular interest in measurement techniques for future mobile systems. Government Departments co-ordinate their work in this area through an inter-Departmental liaison committee on non-ionising radiation.

Legislation and Regulations to Protect the Consumer and the Workforce

23. The safety of mobile phones supplied as consumer products is covered by the General Product Safety Regulations 1994. These Regulations transposed the EC Directive on general product safety (92/59 EEC) into UK law. The Regulations make it an offence to supply consumer products that are not safe in normal or reasonably foreseeable conditions of use. In the absence of a European standard, the provisions of British standards, codes of good practice and the state of art and technology are taken into account in determining whether a product is safe. Thus, the NRPB guidelines for minimising exposure to electromagnetic fields are included in the safety assessment of mobile phones. The GPS Regulations also require the assessment to take into account "the safety which consumers may reasonably expect".

24. Local authority trading standards departments have responsibility for day-to-day enforcement of the GPS Regulations and have powers to remove unsafe products from the market. The Secretary of State also has enforcement powers under the Regulations. If the Government were advised by the NRPB that scientific research indicated that the use of mobile phones posed a safety hazard to consumers or it was shown that equipment was not compliant with the existing guidelines, then it would consider the best methods of dealing with that risk. The options open to Government might include product labelling, mandated supply of hands-free kits or revised handset designs incorporating improved shielding. If the new evidence were to show that mobile phones or certain types of them were "unsafe" within the meaning of the Regulations, then their further supply would be prohibited under the Regulations and, if necessary, action taken against particular suppliers. Existing enforcement powers under the GPS Regulations should be sufficient to achieve this.

25. If the effect of mobile phones was to endanger the health of those in the work place, the Health and Safety Executive could take action under the Health and Safety at Work Act 1974. Similarly, the operators of any installation or equipment, such as a radio-telecommunications base station, which emits an electromagnetic field (EMF) must abide by the 1974 Act. To quote from the draft of a circular, issued jointly by the Department of the Environment, Transport and the Regions and the Department of Health on 8 December 1998, giving advice to local planning authorities on land-use planning and development giving rise to EMFs:

> "[Operators] have the responsibility under this Act [the 1974 Act], and the Management of Health and Safety at Work Regulations 1992, to assess any risk to health and safety which may arise [from any installation or equipment which emits EMFs], including an assessment of likely exposure levels, and to take any appropriate measures. This will include the provision of advice for the protection of the public. As part of this responsibility, the operator of a mobile telephone system . . . would be expected to be able to demonstrate that exposures of employees and the public complied with the NRPB guidelines."

It goes on to say:

> "Under the 1992 Regulations, operators have to carry out a risk assessment which is then used to ensure compliance with the general duties of the 1974 Act. If the assessment showed that there was an area around an EMF source where people may be exposed to electromagnetic fields in excess of the NRPB guidelines, operators would be expected to take measures to restrict access to that area. Such measures could include suitable locked and signed anti-personnel barriers to prevent unauthorised access to areas where people might be at risk."

26. It may also be helpful to note Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition

of their conformity. Both mobile phones and radio-telecommunications base stations are covered by the Directive. The Directive provides, *inter alia,* a framework for the approval of such equipment. Article 3(1) sets down essential requirements applicable to all apparatus. These include "the protection of the health and the safety of the user and any other person". The Directive provides for manufacturers' self-certification of conformity of their apparatus to these essential requirements. The Directive will be implemented in the UK by secondary legislation. Work on the production of the appropriate harmonised standards which manufacturers may choose to use and which would give a presumption of conformity is under way in the European Telecommunications Standards Institute (ETSI).

27. It is important, however, that the Committee should not disregard the likely commercial response to any adverse definitive research. Were the research to show that mobile phones were harmful only when used in a certain way—for example, hand-held use with the phone next to the ear—the industry could be expected to react voluntarily and rapidly to ameliorate concerns by measures such as including hands-free kits or by amended phone designs.

SUMMARY

28. The Department actively participates in the national and international scientific debate on the alleged harmful effects of mobile communications and have consistently supported initiatives that will add to our understanding of the issues involved. We substantially rely on the NRPB for the advice that they have a statutory responsibility for providing. We would add that provision of advice must be independent, cost effective and commensurate with an understanding of the risk.

June 1999

APPENDIX 24

Memorandum submitted by Mr Phil Willis MP

(*Submission by Phil Willis MP (Harrogate and Knaresborough) with supporting evidence from seminar* "Potential Non Thermal Health Effects arising from Cellular Phones, Telecommunications Base Stations and their implications for the General Public." *Held in House of Commons on June 15th 1999.*)[47]

The Seminar was organised by community groups concerned about the health risks associated with mobile phones and base stations.

The papers from the NRPB were not available for inclusion but are available from the NRPB.

My involvement with the campaign to raise awareness on this issue arose from the concerns of a group of my constituents who argued that the siting of a mobile phone base station near their homes constituted a risk to health.

I am not a scientist by profession but I looked to the recognised scientific evidence to assess the degree of risk to my constituents. I also looked to the Government to provide evidence that the risk to health from base stations and from mobile phones was non-existent or at least so minimal that it did not pose a risk.

Unfortunately neither the Government nor the scientific community gave that degree of assurance.

- First, because we simply do not have sufficient peer group validated research to draw firm conclusions.
- Second, because the Government's advisory body the NRPB does not enjoy widespread public confidence. It is not seen as independent because it advises both the industry and the government; it relies on the industry for research funding that further reduces the perception of independence; it is becoming increasingly isolated in its approach to the levels of radiation to which it is prepared to allow the public to be exposed. (In some instances, that level is seven times greater than the level suggested by the International Commission on Non-Ionising Radiation Protection); and it refuses to publicly accept that health risks could be caused by non-thermal effects.

There is considerable research evidence about the thermal effects of microwave radiation and other radio frequency waves. Though not conclusive about the risk from hand sets it is probably sufficient to assure the public about the risks from base stations.

The growing public concern and that of the scientific community is, however, not about thermal effects but biological and epidemiological effects of radio frequency waves at the very low frequencies used in mobile phones and transmissions from mobile telecommunications masts.

Increasing evidence suggests that low-frequency magnetic fields and low-frequency microwave radiation arise from the constantly pulsating signals of mobile phone masts, and that their proximity to electromagnetic fields encountered naturally causes potential biological damage.

So far, research using animals to assess the biological effects has demonstrated cell stress, enzyme activity, genetic effects, gene transcription and hormone production. The biological changes seen in cells, tissues and organisms are similar to changes seen in degenerative diseases such as cancer leukemia, Alzheimer's disease and Parkinson's disease.

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[47] Not printed.

Dr Michael Repacholi of the World Health Organisation, a leading expert in the field, and Dr Russell of the US Food and Drugs Administration, said at a conference in Dublin on 6 March 1998 that until the current WHO research is complete, "the jury is out" on the health risks from low-level electromagnetic fields.

However, the peer validated research evidence on the biological and epidemiological effects of radio waves transmitted at the low frequencies of mobile phones and their base stations is simply not available. The fact that it is not available however does not prove there is no risk.

The NRPB in their evidence to the Select Committee said "The lack of evidence does not, however, prove the absence of a risk and more specific research is warrented". And the research agency of the Ministry of Defence at Porton Down, despite stating that mobile phones are safe, have recently ordered safety shields for the mobile phones used by its staff.

Research evidence by Professor Henry Lai, Research Professor of Bioengineering, University of Washington State USA, Professor Dr Michael Kundi of Institute of Environmental Health, University of Vienna, Austria and Dr Gerald Hyland, Member of the International Institute of Biophysics at Warwick University does not constitute conclusive proof of a health risk but it does indicate genuine cause of concern.

The basis of my submission and of the many campaign groups, which have been set up across the United Kingdom, is quite simple.

— The Select Committee should advise the Government that more independent research is required before mobile phones and their transmitting base stations are deemed not be a risk to public health.

— The Select Committee should advise the Government that until independently validated research is available they should adopt the "cautionary principle" as set out in Article 130-R(2) of the Maastricht Treaty.

Individuals of course may exercise choice over their use of a mobile phone and they have available protective shields. The public who live adjacent to base stations or have them sited in their children's playgrounds have no such choice.

In the absence of evidence, urge caution.

APPENDIX 25

Memorandum submitted by Ms Sarah J Scott

Further to my conversation with Dr Guy Rickett on 22 June, I am sending information to be considered by the Science and Technology Select Committee in relation to government policy concerning the indiscriminate siting of mobile phone base stations.

I attach a short report[48] about the existence of Electrical Sensitivity which I hope will be considered when reporting on the adequacy of current advisory bodies and planning procedures.

There is not yet a huge amount of empirical scientific evidence to back up the existence of this condition, although I believe Dr Olle Johansson, Associate Professor of Neuroscience at the Karolinska Institute in Stockholm, Sweden has recently published significant findings.

However, I would ask you to bear in mind that reports of Electrical Sensitivity do not constitute anecdotal evidence due to the sheer numbers of similar accounts worldwide. For example, conditions such as ME, MS and Gulf War Syndrome cannot be fully explained by medical science and yet are now given official recognition due to the number and consistency of reports of symptoms. Together, reports of Electrical Sensitivity indicate a real phenomenon which deserves intensive investigation.

The NRPB has failed miserably to recognise this condition when setting standards for exposure. Their position that there is "no scientific evidence" to back up the existence of Electrical Sensitivity is untenable due to the fact that they and other scientific bodies have not set up any kind of relevant research program. This is a chicken and egg situtation.

Although those reporting a sensitivity constitute a minority group, their existence highlights the fallacy of the NRPB's guidance that it is not possible for humans to detect and react to low level non-ionising radiation. The statistics within the attached report indicate a problem which needs urgent investigation. Epidemiological research is initially preferable because the variability and individuality of the illness makes it difficult to study under laboratory conditions.

It would be highly desirable for the Science and Technology Select Committee to recommend the instigation of a research programme to collect data relating to the number and circumstances of people reporting symptoms resulting from exposure. Research to demonstrate the existence of a direct biological mechanism is likely to take years, if not decades, to produce and in the meantime it is unacceptable that reports of adverse effects should not be quantified, given that our use of mobile phone frequencies within the population at large is wholly experimental.

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[48] Annex.

I trust that you will give due consideration to the contents of this letter and the attached report. Thank you for your time.

23 June 1999

Annex

A Report on the Nature and Incidence of Electrical Sensitivity, Induced by Exposure to Low Level Non-ionising Radiation

Short-term adverse biological effects, resulting from exposure to low level non-ionising radiation, are already very much in evidence in this country, notably in those people who suffer from Electrical Sensitivity.

The World Health Organisation states that this condition "poses a challenge to conventional wisdom" and that, despite the absence of "any accepted mechanisms to explain hypersensitivity," those "people who claim they are hypersensitive suffer considerably" and "research is continuing."

Symptoms include problems with concentration, dizziness and loss of memory, headaches, nausea, aches in muscles and joints, unusual tiredness, skin disorders, sleep problems, audio/visual disturbance and in extreme cases convulsions. These symptoms occur directly after exposure to low level radiation, such as that generated by domestic appliances, often resulting in sufferers having to adapt their homes accordingly.

Most research to date has been conducted in Scandinavia and in 1996, Per-Arne Ockerman, Professor of Clinical Chemistry in Gothenburg, Sweden, found that damage to red blood cells occurred in electrosensitive persons exposed to low level non-ionising radiation.

One Swedish trade union described a doubling in the number of members reporting serious symptoms of Electrical Sensitivity from 10 per cent in 1993 to 20 per cent in 1996.

Leif Sodergren, of the Association for the Electrically and VDT-injured, estimates that out of a population of eight million, around 10,000 Swedes suffer from Electrical Sensitivity. If this ratio applied in the UK, some 75,000 people could be affected.

In this country, Dr Anne Macintyre of the ME Association states that "ME sufferers seem to be extra sensitive to electromagnetic radiation". There are reportedly between 150,000 and 500,000 sufferers of ME in the UK.

Dr Jean Monro, an expert consultant at the Breakspeare Allergy Hospital, has treated over 500 patients suffering from Electrical Sensitivity. Upon request she has supplied supporting evidence to solicitors, for example, in cases of people forced to seek early retirement as a result of the condition.

Symptoms of Electrical Sensitivity have been consistently reported for a number of years now in many countries, including the US, the UK and Scandinavia. There is a direct correlation between these symptoms and those currently being reported by people exposed to high levels of radiation from mobile phones and masts.

There is now an urgent requirement to fund both biological and epidemiological research into the nature and incidence of Electrical Sensitivity. Until such research has been undertaken, people should not be involuntarily exposed to low level radiation generated by mobile phone base stations adjacent to their homes.

Sarah J Scott

May 1999

APPENDIX 26

Letter to the Committee Specialist from Joan Walley MP

Further to my telephone conversation, I am grateful for the opportunity to submit evidence to the Science and Technology Committee about my concerns that the siting of structures should take account of the precautionary approach and would be grateful if you could bring to the attention of the Committee the work I have done over several years on this issue and the frustration felt in my constituency that notification and planning permissions do not take account of potential health concerns.

I am enclosing various items of correspondence[49] which set out my attempts over the last few years to ensure that these concerns are addressed by the various departments of government, together with Parliamentary Questions[2] and Early Day Motions[50] on this subject.

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[49] See Annex 1 and Annex 2.

[50] Not printed.

My main concern is that masts are currently sited on schools and buildings in close proximity to vulnerable people throughout my constituency. Until future research is done quantifying future possible health risks, I am of the view that no installations should be erected in close proximity to vulnerable groups and people until and unless further research into low energy electro-magnetic fields has been completed.

I have therefore called on the DTI and the DETR to investigate and take account of these concerns and further consider what environmental action and advisory guidance to local government planning authorities is needed.

I remain concerned that, rather than address the potential public health concerns, new planning guidance has concentrated on visible intrusion and refined notification procedures. Instead we should be examining whether or not there are grounds for health concerns. I believe that research is needed and am very much aware that a great deal of the work needs to be done in this area and that it is important to establish who should do this work and how it should be funded.

My further concern relates to government replies concentrating on the thermal effect of telecommunications equipment whilst my concerns concentrate on the long term exposure of extremely low frequency radio emissions. I am very frustrated that in return for relatively small amounts of money, masts are mushrooming right across my constituency on school buildings. At the very least, I would like to see the removal of all masts on school buildings until such time as research has been carried out and completed.

The enclosed correspondence and information, which illustrates the number of mast sites in my constituency, highlights my concerns about the current inability of current notification and planning procedures to take account of public health concerns and that government fully addresses these concerns.

Thank you for bringing this to the attention of the Committee.

28 June 1999

Annex 1

Letter from Mrs Barbara Roche MP to Joan Walley MP

Further to my letter of 18 December on planning regulations for mobile telecommunications base stations, I can now also respond to the additional point you raise in your letter of 24 November 1997 to John Battle in which you suggest development of an overall strategy and formation of an inter-departmental task group to examine the health implications of mobile telecommunications.

Advice on emissions from mobile telecommunications installations and equipment is available from the National Radiological Protection Board (NPPB) who have a statutory responsibility to advise both Government departments and the public. Regular contact between officials of all Departments that have an interest (including my own, DETR and Department of Health) and the NRPB takes place under existing arrangements.

Whilst there has been public concern about possible adverse health effects from mobile telecommunications equipment, as I am sure you have heard before, there is no convincing scientific evidence of harmful effects provided it complies with the relevant NRPB Guidelines.

I hope you find these additional comments helpful.

Please do not hesitate to come and see me on this point.

27 January 1998

Annex 2

Letter to the Department of Environment from Joan Walley MP

TELECOMMUNICATION MASTS: CONSULTATION RESPONSE

I am very grateful for the opportunity to comment on the current consultation document in relation to telecommunication development and I would be grateful if you could take full account of my views. I have no objections to my views being placed publicly on record.

My comments are based on direct experience and concerns expressed in the constituency of Stoke-on-Trent North, following an onslaught of proposals for telecommunication masts. I have also spoken at length with constituents individually and at public and Parish Council meetings.

My initial response is to welcome the publication of the consultation document and the opportunity it gives for wider discussion of the Government regulations on telecommunication masts. Having said that however I am disappointed with the remit of this document which appears to be constrained to planning matters rather than to looking in a holistic way at the relationship of the industry to the terms of reference of the Department of Trade & Industry, and to the remit of the Minister of Public Health. If this consultation document is to lead to adaptations to existing planning regulations then I would like wider account, than is currently given, to be taken of the precautionary principle and public health matters.

My concern about the exclusion of public health concerns relate to various research studies which while not pointing conclusively to possible health effects of those in the immediate vicinity of such masts, have not demonstrated that there are no risks to public health.

To illustrate this I enclose a copy of my recent Early Day Motion[51] as part of this formal application. As my EDM stresses I cannot emphasise too strongly my view that any new regulations should at the very least take account of vulnerable groups such as school children, the elderly and infirm people. In my view telecommunication masts should not be erected in close proximity to these vulnerable groups.

I also understand that there has been a Defence Establishment Research Agency report which supports the view that further research is needed. It is my view that this further research should be the responsibility of Government and that any further recommendations should be incorporated into any reviews and planning guidance in respect of possible harmful effects from telecommunication masts. Above all else it is vital that regulations are based on an up-to-date picture of scientific research in this field including that which addresses concerns in certain quarters—including the effects of elctro-magnetic fields on biological cells.

The crucial point is that there exist concerns about electromagnetic fields and other effects on biological cells. These do not relate to thermal effects—the energy involved is very low and would never be able to produce these. The effects that cause concern relate to ways in which low frequency electromagnetic fields, and possible production of stress proteins or certain enzymes, may lead to health consequences such as those produced by low energy elctromagnetic fields. I hope that this will be explored in conjunction with the Department of Health, to whom I am copying this formal consultation response.

Apart from public health issues, while I accept that the Government is committed to developing the telecommunication industry, I wanted to see far greater accountability and consultation included in the planning guidance procedures. Concerns about both landscape issues, and up to now too little opportunities for information and consultation, have been adequately covered in submissions from Staffordshire Moorlands District Council, Stoke-on-Trent City Council and the Parish Council, whose responses I also enclose[52] and I wish to re-inforce the views of these local authorities in my constituency.

Finally there is the matter of the ability of the Government in this consultation exercise to address the real issues underpinning future development and the extent to which the proposed changes relate to the fact that digital phones and networks are different to analogue phones and networks.

This consultation document gives us an overdue but welcome opportunity to review planning guidance. It is imperative that the opportunity is not lost and that Government now examine the issues in the widest possible sense. I look forward to inclusion of the precautionary approach in respect of public health concerns being incorporated into any new planning regulations/guidance arising from this most welcome consultation exercise.

25 September 1998

APPENDIX 27

Supplementary memorandum submitted by the National Radiological Protection Board

Letter to the Committee Specialist from Professor Roger Clarke, Director

Thank you for your fax requesting information on the budget for mobile phone research funded from the government grant.

The figure of £588,000 you quote for EMF research came, I think, from last year's Corporate Plan, not the Annual Report.

For the current financial year, 1999–2000, the EMF research budget has increased to £805,000 of which £550,000 is from the grant. About half of this expenditure is now devoted to mobile phones—say £300,000—and represents a shift of emphasis from power line to microwave frequencies.

R H Clarke

6 July 1999

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[51] Not printed.

[52] Not printed.

APPENDIX 28

Supplementary memorandum submitted by the Department of Health

SELECT COMMITTEE ADDITIONAL QUESTIONS REQUESTED IN LETTER TO JIM FOWLES DATED 15 JUNE

We have subsequently had a further request through Jim Fowles for the names of the members of the Mobile Phones Expert Group or if not available, the expertise of the members. This information has been added after question 7 below.

QUESTION AND REPLIES

1. *A DH press release (8 April 1999) stated that members of the mobile phone independent expert working group would be drawn from "the relevant scientific fields, consumers and the industry" but Ms Jowell told the Committee that "we should not have representatives of the industry on the advisory group" (Questions 15 and 29 in the transcript). What has caused this change in policy?*

On reflection, we did not consider that it was in keeping with the independence of the group to include a representative from industry or consumer groups. We took the same view in respect of a proposal to include a member of the NRPB Board in the membership. We will be consulting industry and consumer groups during the course of the work of the Group and inviting them to present evidence. This will enable us to ensure that industry and consumer groups are as widely represented as possible.

2. *What is the process for identifying and appointing consumers to the expert working group? (See Question 16) Will these posts be advertised? How will you ensure that these individuals can represent consumer interests?*

Proposals for membership of the Group will need to be prepared by the Chairman of the NRPB in consultation with the Chairman of the Group—Sir William Stewart—and submitted to Ministers for approval. Lay persons are often represented on Department of Health Committees. Department of Health officials and the Public Appointments Unit in the Cabinet Office have been made available to provide assistance in this matter. In addition, consumer group interests will be invited to give evidence.

3. *When the Committee looked at GM foods, it recognised that statements such as "no evidence of risk" were not enough to reassure the public on safety. The NRPB tells us that there is "no human evidence of a risk of cancer resulting from exposure to radiations that arise from mobile phones" but there has been a small number of studies showing possible links between microwaves and cancer. These studies have received recent media attention. How should the public react to this?*

Studies claiming an association between a particular risk factor and a health outcome are not uncommon. It is rare for a particular single study to provide proof or even be strongly suggestive that such a link is causative. Claims arising from scientific studies must be carefully evaluated by experts who understand issues such as research study design, the adequacy of sample sizes, the need for case definitions and the criteria for follow-up. Elwood, (Elwood JM. A critical review of epidemiological studies of radiofrequency exposure and human cancers, *Environ Health Perspect* 107 (supp 1) 155–168, 1999) has recently reviewed the epidemiology literature and found no consistant association between radiofrequency emissions and cancer. However, we have asked the expert working group also to look at the subject. We agree that it is difficult for the public to understand some of the complex concepts and it is important that a proper review of the evidence is widely publicised so that people can see what experts say about studies which have made claims about risk.

4. *In view of the fact that there is some evidence to suggest potential health risks, can you say that you are applying the precautionary principle in the case of the mobile phones?*

The duty of Health Ministers is to educate the public about health risks and offer real protection where those risks justify it. Sometimes we need to adopt a precautionary approach where there are uncertainties or gaps in our knowledge. But we must not take this to extremes as this could lead to bad or irrational decisions which society could not afford. There is currently much discussion in this country and in Europe about what is meant by the "Precautionary Principle". We would define this as "where there may be threats of serious damage to human health, lack of full scientific certainty should not be used as a reason for postponing proportional measures to reduce such threats." Existing guidelines on exposure are precautionary albeit in respect of established effects.

5. *Would you consider introducing regulations to bring about health warning labels or exposure figures on mobile phones?*

The Department of Trade and Industry take the lead on these issues in consultation with DH and NRPB. Our view is that the introduction of exposure figures on phones could be misleading. It could lead to a belief that a higher exposure is more dangerous even though it is not proven. We would not consider health warnings currently to be necessary or advisable since phones comply with the national guidelines.

6. *What do you think can be done to improve the way risks and uncertainties are communicated so that the public is not immediately alarmed by hyped up scare stories?*

Openness, transparency and trust are probably the key to dispelling public fear. We need to ensure that risk communication is a two way process and that there has been wide consultation during the decision-making process. This includes involving "lay" or consumer representatives in the decision making and making widely available the information on which decisions were based in an understandable form. In the early stages of the development of a new technology information is likely to be sparse. True consensus may take a while to emerge during which time the media may publicise novel, but ultimately unfounded views. We believe that independent bodies of experts can be an effective source of authoritative advice, particularly where that advice is developed with the understanding and scrutiny of consumer representatives. We set out guiding principles for improving the communication of health risk in the White Paper "Saving Lives—Our Healthier Nation". The guiding principles in our approach to risk are:

- high quality assessment of science;
- full risk/benefit evaluation;
- consistency of approach across risk areas;
- clear framework of interventions;
- approach should have integrity if judged in retrospect;
- protect the vulnerable;
- realistic sharing of uncertainty;
- information should provide insight; and
- greater public participation in risk deliberations.

The White Paper also set out proposals to establish a health risk phone line.

7. *Do you see this issue assuming the same political proportions and seriousness as the recent GM foods issue? In what ways do you see these issues as different?*

The issues are very different. Mobile phones are extremely popular, widely used throughout the world and growing in the breadth of the technological features which consumers are demanding. Consumers have exhibited no such demand for GM food as apparently they do not see any particular direct personal benefit of this technology used in crop and food production. Thus, they are not balancing feared risks against benefits to them as individuals in exercising this consumer choice.

Supplementary information about the new Expert Working Group

Membership has been discussed but not yet finalised. It would therefore be inappropriate to put suggested names into the public domain. However, the spectrum of expertise aims to encompass the following disciplines:

- Scientists in epidemiology and experimental biology with a knowledge of research related to exposures to electromagnetic fields.
- Medical and scientific skills in oncology, physics, statistics and neurophysiology. At least one member should come from outside the UK.
- Social science, public perception of risks and legal issues. Cross membership with the NRPB's Advisory Group on Non-ionising Radiation.

Details of the other membership expertise and observers are under discussion. NRPB would provide the Secretariat and administrative support.

The proposed terms of reference have been put forward "To conduct a rigorous assessment of existing research and to identify areas where further research may be needed so that the public can receive clear and well considered advice about any risks from the use of mobile phones".

It is the intention to consider both the use of mobile phones themselves and the exposures from base stations and also to cover how information is communicated to the public.

12 July 1999

Annex

MOBILE PHONE RESEARCH

RESEARCH INTO EMF (INCLUDING MOBILE PHONES) EFFECTS

It should be noted that a description of mobile phone research in isolation could be misleading and may best be described in the context of research into the health and biological effects of electromagnetic fields in general. Moreover, the UK recognised the need for better quality research on the human health effects of electromagnetic fields and DH and HSE have therefore led in providing a forum to co-ordinate Government sponsored research. In some cases, the NRPB has offered its resources and considerable expertise in organising workshops and providing advice. In other cases direct Government funding has been more appropriate.

Mobile Phone Research

UK input at European Community Level

In 1996 the European Commission set up an Expert Group to draw up a "blueprint for research" into possible health effects relating to mobile telephony. The Head of NRPB's Non-ionising Radiation Department chaired the Expert Group which reported to the Commission in September 1996. The Group recommended a comprehensive research programme covering cellular studies, experimental investigations in animals, human volunteer studies and epidemiology. This work is being taken forward as the workplan for the EC Fifth Framework Programme is being developed. One of these projects is a multinational epidemiological study of the causes of brain cancer. This study, under the auspices of the International Agency for Cancer Research, has progressed through a planning and pilot stage to preparations for the full epidemiological investigation. DH has been in discussion with the researchers for two years about the section of this study investigating mobile phone use and has agreed to contribute funding amounting to £120,000 over three years out of an expected total budget of more than £2 million.

Other research

The Department funds and manages a programme of work on radiation protection research. Part of this programme is concerned with non-ionising radiation such as that associated with power lines and mobile phone frequencies. When selecting projects for funding we have been careful to channel resources effectively. In some cases it has been more appropriate to contribute to large-scale international initiatives (eg the WHO EMF project) than funding small-scale individual projects. In other cases it has been more valuable to the research community to provide a forum and the facilities to develop protocols in preparation for future research.

The World Health Organisation (WHO) International EMF Project

This comprehensive study of EMF effects, including radio waves, is now into its third year and will lead to a number of published reviews and recommendations for further research. The HSE and DH have each provided £20,000 per year for five years to this project. HSE staff are on the management committee on behalf of the Government. The wealth of NRPB's expertise is also available to this project as a WHO collaborating institution.

International Workshop

An international workshop on exposure measurements for EMF epidemiology was held at the NRPB in September 1998. It was run by the head of NRPB's Non-ionising Radiation Group Dr Alastair McKinlay who is the vice Chairman of the International Commission on Non-ionising Radiation Protection (ICNIRP) and internationally renowned scientific expert in the field.

NRPB Research

The NRPB undertakes research and reviews of research on effects of EMF on human health and biological systems. The NRPB also has some of the most advance techniques and expertise in the measurement of EMF and has been advising and collaborating in the measurement protocols for major epidemiological studies.

Occupation Exposure Research

A three-year study in the UK of occupational exposure to radiofrequency fields was launched in November 1998. This study is not about phone use *per se* but will consider radio waves in an occupational setting and possible long-term health effects. DH and HSE have been on the steering committee of this project since its inception and were instrumental in persuading industry to provide funding.

DH Mobile Phone Research

The Department of Health is funding its own modest research on electromagnetic field effects. Two of these (marked * below) have been specifically concerned with mobile phone exposures: one project on animal behaviour and one on human cognitive function. The cost of these projects together was approximately

£60,000 per year for two years. The results of the second study on mobile phone usage and cognitive ability from researchers at the University of Bristol has recently been published. The DH EMF research projects are listed below.

DH EMF Research and Projects (* Indicates Mobile Phone-Related)

1. Non-ionising radiation risk perception in exposed and non-exposed subjects and their response to information on the nature of risk. B Stollery, A Smith and A W Preece (University of Bristol), 1997–99, £108,000.

2. Public perceptions of radiation risks. Implications for the assessment and development of effective intervention strategies. S Hunt, L Frewer and D Shepherd (Institute of Food Research), 1996–99, £170,000.

3. Early responses of normal and potentially hyper-susceptible human cells to low frequency electromagnetic fields. J E Arrand, S Gamble, A Okyre-Boateng, I Sutherland (Brunel University) and M Dunn (Harefield Science Centre), 1996–99, £169,000.

4. The role of EMF fields in perturbing signal induction and cell cycle control mechanisms in human cells *in vitro*. K M Rise, M Folkard, B D Michael (Gray Laboratory Cancer Research Trust), J F Chapman-Andrews, K Turnpenny (Taywood Engineering Ltd) and K Bromley (Building Research Establishment), 1997–2000, £181,000.

*5. Effects of radiofrequency radiation on long term potentiation and behaviour. J E H Tattersall (CBD Porton Down), 1997–98, £113,000.

6. Electromagnetic fields and airborne pollutants. A P Fews and D L Henshaw (University of Bristol), 1998–99, $40,000.

*7. Effect of microwaves on cognitive function in humans. A W Preece (University of Bristol), March 1998 to April 1998, £3,400.

8. Study of childhood cancer and electromagnetic field exposure from power lines. G J Draper and T J Vincent (Childhood Cancer Research Group), 1998–2000, £156,000.

12 July 1999

APPENDIX 29

Letter to the Committee Specialist from Dr Alf Roberts, Chief Executive and Secretary, the Institution of Electrical Engineers

You asked whether the IEE would be prepared to make a formal submission of evidence to the Committee on the topic of mobile phone safety, addressing both transmitter base stations and mobile hand-held telephones.

The Institution does not propose to make a formal submission of evidence to the Science and Technology Committee at this stage, since there is no hard scientific fact on which to base that evidence. However the members of the Committee may find the factual information below of assistance in its work.

The Institution of Electrical Engineers has a membership of almost 140,000 professional engineers representing a wide range of engineering disciplines including power engineering, electronics, communications, computing, software engineering, and manufacturing. The Institution has responsibility for the accreditation of first degree engineering courses and for ensuring that membership of the profession is only granted to those with the appropriate qualifications and experience. The IEE considers that engineering is an essential element of our society, necessary for national wealth and well being.

The Institution of Electrical Engineers has monitored claims for the biological effects of radiation for a number of years, concentrating on low and mains frequencies. About two years ago the role of the Biological Effects Working Party, as the committee is called, was extended to include microwave frequencies, including those used by television, FM radio and mobile telephony. Membership of the Working Party was extended to include acknowledged and independent expertise at these higher frequencies. A staff member of the National Radiological Protection Board also sits on the Working Party.

The Working Party operates by carrying out peer reviews of all the available published scientific papers relating to biological effects of radiation in the DC to microwave frequency range. It assesses papers for quality of science, validation of results by other workers, the value of the work to increasing scientific understanding and a number of other metrics. The Working Party reviews approx 1,400 papers per annum from a wide-ranging computerised literature search. The Working Party will continue this surveillance of scientific papers. The Institution believes that it makes an important contribution to public awareness on this topic.

As a result of this work it has concluded that to date there is no convincing evidence to support the contention that transmitter base stations and mobile hand-held telephones cause any damage to human health. Further scientific investigation and validation will be required to determine whether the use of mobile hand-held telephones can cause any measurable effect in human beings—and whether any effect that may be discovered and confirmed can have any possible effects on human health.

I hope this explanation of the Institution's position is of help to the Committee. Please contact me again if there is any way that you believe that the Institution can be of further assistance at this stage.

22 July 1999

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